


Morbidity and mortality pattern of leptospirosis in Galle District, Sri Lanka: A descriptive analysis based on disease surveillance

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ABSTRACT

Introduction: Leptospirosis is considered as one of the most common zoonotic diseases in Sri Lanka, which has a high case fatality rate. This study was conducted to assess the morbidity and mortality pattern of leptospirosis in the Galle District.

Methods: A descriptive cross-sectional study was conducted based on information on leptospirosis in the Galle district obtained from the disease surveillance system. Data were extracted from the publicly available website of the Epidemiology unit which was collected through the routine disease surveillance system based on H 399, special surveillance forms and death investigation forms available at the Epidemiology unit, Galle district.

Results: Data of monthly notified incident cases of leptospirosis had a trend and seasonality. Seasonal peak cannot be limited to a specific time duration. A rapid increment of notified incident cases of leptospirosis was reported in 2020. Elpitiya and Karadeniya medical officer of health (MOH) areas were identified as endemic areas for leptospirosis in Galle district while people involved in cinnamon cultivation were identified as a risk group additional to paddy workers. A total number of 75 deaths was reported for the past six years (2017 to 2022) while 2017 had the highest case fatality rates (4.3%). The majority of deaths (80.8%) occurred with complications of acute kidney injury followed by pulmonary haemorrhages (69.2%) while multi-organ failure was observed in 23.1% of deaths.

Conclusion: Disease morbidity and mortality patterns had geographical variations. This should be considered during the implementation of preventive and curative measures in leptospirosis management.

Keywords: *Galle district, leptospirosis, morbidity and mortality pattern.*

Introduction

Leptospira spp. is the causative agent of the bacterial zoonosis known as leptospirosis. It mainly happens in trophic and sub-trophic nations. The disease spreads more frequently as the humidity and rainfall levels rose. Due to a lack of diagnostic tools and surveillance, the disease has been both

underreported and underestimated worldwide and there is no exception in Sri Lanka. In Sri Lanka, leptospirosis is still endemic, with only brief respite. Ratnapura, Kegalle, Kalutara, Galle, Matara and Badulla are the districts with the highest endemicity in Sri Lanka. Cases of leptospirosis and

related fatalities have been rising in Sri Lanka during the past few years, particularly in the endemic regions. Due to the development of the health sector and surveillance services in Sri Lanka, reported cases have increased but still it remains a neglected and underreported illness (1).

Surveillance system and leptospirosis

A disease surveillance system includes routine communicable disease notification. Since 1897, Sri Lanka has had a legislative required for communicable disease notification (2). There is a list of notifiable diseases and leptospirosis is included under category B of the list while it is identified as a disease that requires special surveillance. A medical practitioner or person professing to treat diseases, who attends on any person suffering from leptospirosis or on suspicion must notify the disease. Case investigation forms which are forwarded to Epidemiology Unit from sentinel sites and fields were considered under special surveillance and death investigation forms were collected to gather information for in-depth assessment of the disease under surveillance. At the Epidemiology Unit, the data are entered into a centralised database which is called “e-surveillance”. At the divisional, district, and national levels, it has an internal monitoring system. This gives the framework for managing and preventing the illness that might endanger the general public's health. By analysing those routinely collected data, patterns of leptospirosis can be identified which can be utilised for planning preventive and curative interventions for disease control activities (2). This process needs to run smoothly for disease prevention and control activities, hence early investigation and return are essential.

Methods

A descriptive cross-sectional study was conducted to assess the disease trend and mortality pattern of leptospirosis in the Galle district for 13 years duration. Data were extracted from the Epidemiology Unit website with permission of the Epidemiology Unit of the Regional Director of Health Services (RDHS) Office, Galle. The number of notified cases, number of confirmed

cases, and number of deaths according to Medical Officer of Health (MOH) areas were extracted from the “e-surveillance” web page of the Epidemiology Unit. Monthly notifiable leptospirosis cases in Galle District were obtained from January 2010 to December 2022 to assess the trend and seasonality of leptospirosis while data on notified and confirmed cases of leptospirosis were extracted from January 2015 to December 2022 MOH area wise. A total number of deaths reported from 2017 to 2022 were extracted from records available at the Epidemiology unit of RDHS Office, Galle. Death related information was reviewed based on death investigation forms available at the epidemiology unit, RDHS, Galle for a four year duration (2019 to 2022). The case fatality rate was calculated for each year based on the total number of deaths per number of confirmed leptospirosis cases per year. Data were analysed using *Minitab* statistical software.

Results

Morbidity and mortality pattern of leptospirosis in Galle District were assessed under three components; Trend and seasonality for incident cases, endemic areas, and mortality pattern.

Trend and seasonality for Incident cases of leptospirosis in Galle district

Data of monthly notified incident cases of leptospirosis in Galle district were obtained for 13 years (2010-2022). Data were summarised and presented using a time series plot. A total of 67,168 incident cases of leptospirosis were reported for the past 13 years in Sri Lanka. Among them, 5,949 incident cases (8.9%) of leptospirosis were reported in Galle district with the highest number of cases (n=1,214) in 2020. Based on the total incident cases reported during the given time frame, Galle District only behind Rathnapura (n=9,646) and Kalutara (7,109) districts. Monthly notified incident cases in the Galle district were not static concerning mean and variance. Trend* and seasonality** were observed (Figure 1).

* *Trend - a pattern in data that shows the movement of a series to relatively higher or lower values over a long period of time*

** *Presence of variations that occur at specific regular intervals less than a year*

The number of monthly notified incident cases of leptospirosis has increased with time indicating a trend of leptospirosis. In each year two peaks of monthly notified incident cases of leptospirosis were noted indicating seasonality of notified incident cases of leptospirosis. However, the pattern of seasonality has changed with time as depicted in the time series plot. Hence, seasonal peaks cannot be limited to a specific time duration.

Notified incident cases of leptospirosis and confirmed cases out of notified cases have increased with time (Table 1). A rapid increase of notified incident cases of leptospirosis was reported in 2020. The proportion of confirmed cases out of notified cases was at an unsatisfactory level.

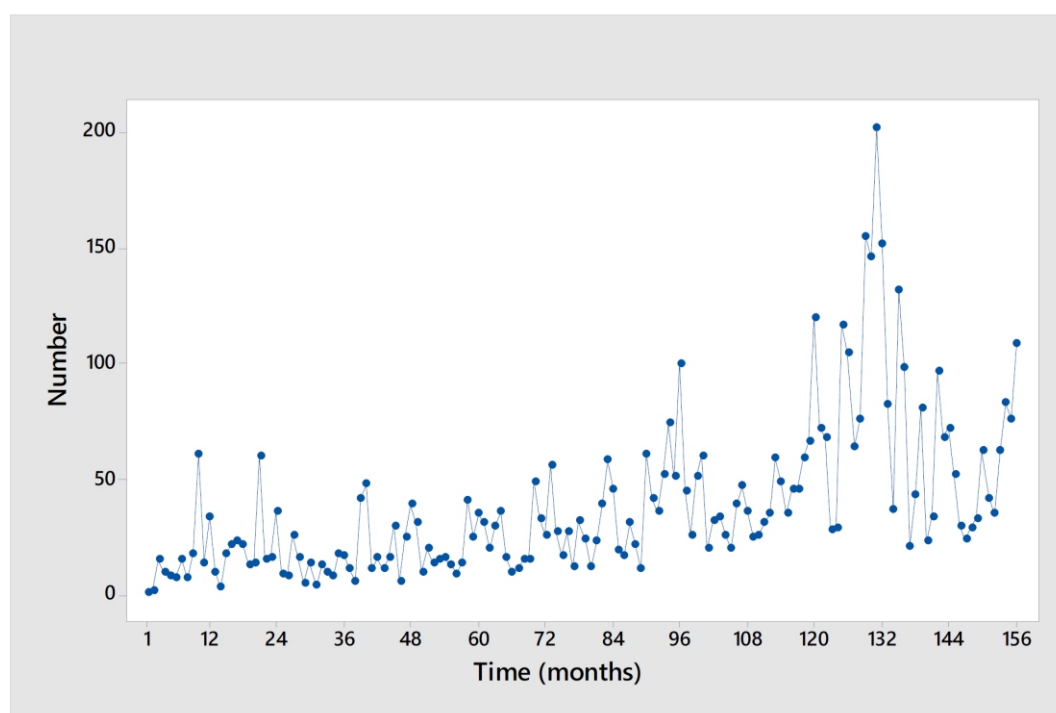


Figure 1: Time series plot for monthly notified incident cases of leptospirosis in Galle district (2010 - 2022)

Table 1: Leptospirosis cases: Notified and confirmed January 2015 - December 2022

Year	Notified cases	Confirmed cases	Proportion of confirmed cases out of notified cases
2015	276	210	76.1%
2016	370	246	66.5%
2017	546	372	68.1%
2018	436	319	73.2%
2019	597	380	63.6%
2020	1214	867	71.4%
2021	788	514	65.2%
2022	613	501	81.7%

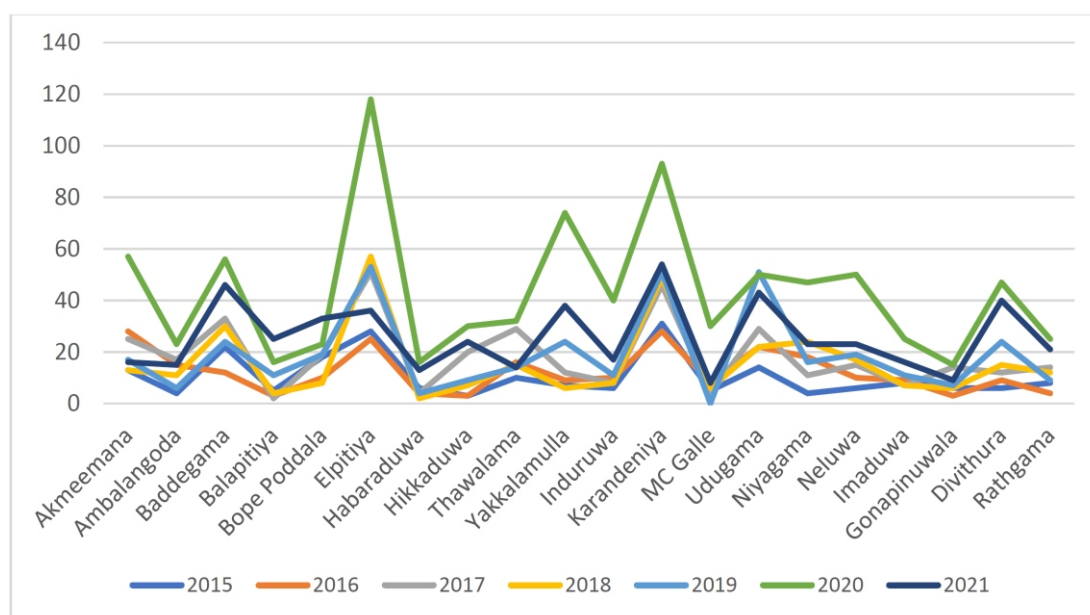


Figure 2: Number of yearly notified incident cases of leptospirosis according to MOH area (2015-2021)

Endemic areas for Leptospirosis in Galle District

Endemic areas for leptospirosis in the Galle district were identified based on yearly notified incident cases and deaths reported based on MOH areas (Figure 2). Elpitiya, Karadeniya, Udugama, Baddegama, Yakkalamulla, Akmeemana, and Divithura MOH areas were identified as endemic areas for leptospirosis in the Galle district. Among those MOH areas, Elpitiya and Karadeniya MOH areas were identified as endemic areas for leptospirosis with a risk individuals involved in cinnamon cultivation other than paddy field work. However, other MOH areas mainly focus on paddy cultivation in the Galle district.

Mortality pattern of Leptospirosis in Galle district

A total number of 75 deaths due to leptospirosis were reported from January 2017 to December 2022. Among them, the majority were reported in 2020 (n=18, 24.0%) followed by 2017 (n=16, 21.3%) while in 2017 had the highest case fatality rates (4.3%). The cumulative case fatality rate in Galle district for past six years is 2.5%.

Among reported deaths due to leptospirosis, the majority were males (n=50, 66.7%). Nearly half of deaths were reported in the age category of 35

to 60 years (n=40, 53.3%) followed by 60 years and above (n=25, 33.4%) and below 35 years (n=10, 13.3%). Karadeniya (n=16, 21.3%), Elpitiya (n=9, 12.0%), Baddegama (n=7, 9.3%), Udugama, Rathgama, and Divithura (n=5, 6.7% for all) were identified as risk MOH areas with the highest percentage of reported deaths. Except for two deaths, all others were reported from the Teaching Hospital Karapitiya (THK) (n=73, 97.3%).

Fifty leptospirosis deaths were reported in the last four years in Galle District (2019 - 2022). Among them, RDHS office Galle received, 26 (52.0%) reports on death due to leptospirosis under institutional death review. Most patients had first sought medical advice from a government hospital but 65.4% (n=17) deaths had happened with delayed admission following the onset of symptoms (more than three days following the onset of symptoms). All the deaths occurred at Teaching Hospital Karapitiya, but the majority (n=21, 80.8%) of patients were transferred to THK following admission to a peripheral hospital. Delays in transfers were identified in 2 cases (9.5%). Among 26 deaths, the results of microscopic agglutination test (MAT) available for 14 patients (53.8%) and all were positive for IgM.

Table 2: Mortality pattern of leptospirosis in Galle District

Year	Number of deaths reported	Percentage	Case Fatality Rate
2017	16	21.3	4.3%
2018	09	12.0	2.8%
2019	10	13.3	2.6%
2020	18	24.0	2.1%
2021	11	14.7	2.1%
2022	11	14.7	2.2%
Total	75	100.0	2.5%

Table 3: Complications of leptospirosis among died patients due to leptospirosis (n=26)

Complications	Number	Percentage*
Acute kidney injury	21	80.8%
Pulmonary haemorrhage	18	69.2%
Myocarditis	10	38.5%
Septicemia	9	4.6%
Liver failure	8	30.8%
Multi organ failure	6	23.1%

* Percentages did not add up to 100% due to multiple responses

All the deaths had occurred following complications due to leptospirosis. The majority (n=21, 80.8%) were complicated with acute kidney injury (AKI) followed by pulmonary haemorrhages (n=18, 69.2%) while multi-organ failure was observed in 6 patients (23.1%) (Table 3).

Discussion

This study was conducted to assess the morbidity and mortality pattern of leptospirosis in Galle District, Sri Lanka. The study revealed important aspects that needs attention for preventive and curative care of leptospirosis. It was found that monthly notified incident cases of leptospirosis in the Galle district had disease trends and seasonality based on time series analysis.

Interestingly, monthly notified incident cases of leptospirosis in Sri Lanka had trend and seasonality according to a national study conducted in 2020 compatible with Galle District findings (3). Hence, the disease trend and seasonality pattern of the Galle District follows the national trend and seasonality. As Galle District has been identified as one of the districts with the highest incidence of leptospirosis in Sri Lanka (4), there is no wonder of having the same pattern. The trend of leptospirosis incident cases revealed a gradual increase of incident cases probably due to the improvement of the disease surveillance system of the country, the introduction of a special surveillance system for leptospirosis, and the investigation mechanism for leptospirosis deaths. Being an endemic area for leptospirosis and having an excellent active

public health service section within the Galle district may have contributed to give compatible results with national findings.

Although seasonality is observed for incident cases of leptospirosis, it is difficult to locate seasonal peaks for a specific time duration as pattern of seasonality had variation with time in the present study. Although leptospirosis outbreaks were noted in paddy cultivation seasons and following floods in Sri Lanka (5), changes in rain patterns (6) and leptospirosis outbreaks related to other cultivations (7) may have contributed to this difference. This is further proven by identifying Elpitiya and Karadeniya MOH areas as endemic MOH areas for leptospirosis in Galle District while these two MOH areas cinnamon cultivation more than paddy cultivation. Hence engaging in cinnamon cultivation are identified as a risk category for leptospirosis and this may need investigation through future research.

A rapid increase of notified incident cases of leptospirosis was reported in 2020 in Galle District. As explained by Warnasekara and Agampodi, the largest outbreak of leptospirosis in Sri Lankan history was reported in 2020 following the disruption of routine health systems and the surveillance of infectious diseases with the effect of the disease transmission dynamics of the COVID-19 pandemic (5). Therefore, it is clear, that Galle district is no exception in high disease incidence in 2020. The COVID-19 pandemic led to lockdown and social distancing, where people were more prone to stay at home and get involved with cultivation. This may significantly attribute to the leptospirosis outbreak in 2020 (5). Furthermore, the literature did not show any other possible explanation for the leptospirosis outbreak in 2020. A leptospirosis outbreak was noted in 2008 including Galle District showing a similar pattern (8), but no specific reason was identified for the outbreak in 2008 as well.

Confirmation of leptospirosis cases during special surveillance systems is not satisfactory at the national level. According to Agampodi S, *et al.*, out of the 404 possible cases, 155 were confirmed to have leptospirosis in 2008 in three endemic districts in Sri Lanka by giving an unsatisfactory level of confirmation (38.4%) (8). Not having enough facilities for serological confirmation of diagnosis,

confirmation of leptospirosis done in routine practice based on clinical judgment are possible reasons. Even for reported leptospirosis deaths, serological confirmation was available for only 53.8% deaths according to the present study. With these limitations, confirmation of leptospirosis cases by special surveillance remains around 70% in Galle district, and at the national level, there may be no exception. This had badly affected the calculation of the case fatality rate of leptospirosis at the district level as well as at the national level. Underreporting of leptospirosis, poor health-seeking behavior, as well as inadequate surveillance, will further contribute to masking the actual disease burden of leptospirosis. Hence disease surveillance system needs to be strengthened by giving special attention to special surveillance. This can be achieved through the MOH system with the help of public health inspectors, Having around 70% coverage in the Galle district, this can be improved through necessary interventions like prompt supervision of PHI duties.

A total number of 75 deaths were reported from January 2017 to December 2022 in Galle District with a high case fatality rates (4.3%) in 2017 and 2020. Case fatality rates for leptospirosis are available in the local context in literature with different values. A study done by Agampodi S, *et al.*, found that the case fatality rate was 2.8% in 2008 for reported cases (8) while another study done by Agampodi S, *et al.*, in 2008 in three leptospirosis endemic districts in Sri Lanka revealed the case-fatality rate as 1.3% (8). When comparing these study results with findings in the Galle District. Galle district had a higher cumulative case fatality rate (2.5%) in the past six years. As proportion of confirmed leptospirosis cases can differ from district to district, comparison of leptospirosis case fatality rate is difficult. However, by assuming that there is no huge difference in those proportions this comparison can be done and if so, Galle District has a higher case fatality rate. The pooled case fatality ratio for leptospirosis was estimated by Warnasekara *et al.*, and it was 7.0% with a 95% confidence interval of 5.2% to 9.4% (9). As it is much higher than reported, a more accurate calculation of the case fatality rate will be required at district and national levels through a better surveillance system to assess the actual leptospirosis disease burden.

Karandeniya and Elpitiya MOH areas were identified as high risk MOH areas from the study with the highest percentage of reported deaths in the Galle District for past six years. As these two MOH areas have the highest leptospirosis incidence rate, there is surprise in having the highest death rates. Interestingly, almost all leptospirosis deaths occurred at THK. As the death investigation revealed, critically ill leptospirosis patients were transferred to THK from peripheral hospitals in the Galle District for further management. However, delays in transfers were identified in 9.5% of deaths. Hence, timely decisions to transfer patients should be taken by clinicians if they do not have adequate facilities to manage the patient in peripheral settings. Moreover, to minimize the mortality rate, facilities should be improved at least in all base hospitals to manage critically ill patients. Although almost all patients had first sought medical advice from government hospitals, 65.4% of deaths has occurred happened with delayed admission following the onset of symptoms. Hence community awareness will be required to improve health-seeking behavior. Moreover, healthcare professionals should be competent in early detection and to make prompt referrals to minimize complications.

Compared to our study, a study by Agampodi S, *et al.*, acute renal failure was identified as the main complication (14.8%), followed by myocarditis (7.1%) and heart failure (3.9%) (9). Another study revealed that the most common organs involved were the kidney, liver, and heart, with median rates of 48.7%, 30.0%, and 14.2%, respectively (10). However, the present study assessed complications in patients who have died while literature showed complications of living patients at the time of analysis. Hence having a higher percentage of complications in leptospirosis deaths in the present study is a compatible finding. A higher proportion of pulmonary haemorrhages among deaths was identified as an interesting finding in the present study which is compatible with a study done by Herath, *et al.*, in the same district in 2019 (11).

With this evidence, the present study reveals important aspects of morbidity and mortality pattern of leptospirosis in Galle district which is important to plan preventive and curative programmes. Galle district, being is an endemic

area for leptospirosis, the findings of the present study may be applicable even at the national level for other leptospirosis endemic areas in the country.

Conclusions and recommendations

Trend and seasonality were observed for incident cases of leptospirosis in the Galle district. The seasonal peak cannot be limited to a specific time duration as a pattern of seasonality has a variation with time based on a multitude of factors. Morbidity and mortality of leptospirosis had geographical variation within the Galle district and two MOH areas Elpitiya and Karandeniya were identified as high-risk endemic areas putting people engaging in cinnamon cultivation at risk in addition to well identified paddy cultivators. As pulmonary complications have been identified in the current study among leptospirosis deaths which is not identified in existing literature, especially in other parts of the country, clinician's attention should be focused on possibility of pulmonary haemorrhage during the management of leptospirosis. Gaps in the prevailing surveillance system and under-reporting, neglected nature of the disease by community and health care professionals, inadequate facilities at peripheral hospitals for the management of leptospirosis, and late presentation due to poor health-seeking behaviour adversely contributed to morbidity and mortality indicators of the disease. Hence launching preventive measures for leptospirosis remains a challenge and the study recommends addressing above gap for better management of the disease. Although these findings are based on a local study, as they reflect national figures, these recommendations can be incorporated at the national level to strengthen the national programme of leptospirosis, in Sri Lanka.

There is no conflict of interest for the study.

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