Review article

The climatic factors associated with incidence of Leptospirosis in Sri Lanka

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Abstract

Leptospirosis is an endemic disease of public health importance in Sri Lanka. An ecological study was conducted to describe the association of selected climatic factors with district level incidence of Leptospirosis in Sri Lanka between 2008 and 2011. The factors selected were rainfall, rainy days, temperature and humidity. Districts were categorized in to districts reporting high, moderate and low incidence of Leptospirosis based on annual average incident rate of Leptospirosis.

In general the present study did not find statistically significant correlation between climatic factors with district level Leptospirosis incidence, though a positive correlation between rainfall and incidence of Leptospirosis was found in majority of districts with high incidence of Leptospirosis. However, the observed correlation was statistically significant only in two districts.

Sri Lanka is a country with minimal fluctuation of climatic factors (eg: temperature, humidity) among districts. It may have an impact on the poor correlation between climatic factors with incidence of Leptospirosis cases. Rainfall being positively correlated with Leptospirosis incidence in high incidence districts may suggest the rainfall to play a more important role in Leptospirosis epidemics than endemic transmission. Hence Public Health authorities need to strengthen control and preventive measures during the period of monsoon rains especially in districts with high incidence. Since this is an ecological study, further research is needed to assess the present study findings.

INTRODUCTION

Leptospirosis is a zoonotic disease which is endemic in Sri Lanka and is of great public health importance due to the high morbidity and the mortality that have occurred as a result of this disease. It was first described in Sri Lanka in 1953(1). In the early days, it is recorded that the reporting varied from time to time and place to place depending on the interest of the clinician who worked in the respective area(2). In 1959 the first leptospira (*L. icterohaemorrhagiae)* was isolated from the blood of a patient in Colombo and followed soon after by isolation from the kidney of a sewer rat trapped in the vicinity of that patient's home(2). It is not clear how the disease evolved in Sri Lanka in 1970's and 1980's. However, notification data on suspected Leptospirosis patients is available at Epidemiology Unit from 1991 and show the disease to be endemic with outbreaks occurring every 4 to 5 years (3). Outbreaks have been witnessed in certain years such as 2008 and 2011. Magnitude of the problem is such that during 2008, 2009, 2010 and 2011 a total of 7423, 4980, 4545 and 6689 cases of Leptospirosis was notified to the Epidemiology Unit from the entire country(4). The Deaths due to Leptospirosis too warrant action to control the disease with each year in the recent past approximately more than 100 deaths have occurred due to Leptospirosis (4). The Case Fatality Rate (CFR) for Leptospirosis too is a concern with CFR being over 2% in 2008 2010 year.

In order to effectively control and prevent the disease, it is important to identify the factors associated with its spread. Seasonality of human

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Leptospirosis has been found to be associated with the meteorological data such as cumulated rainfall and mean monthly temperature in a study conducted in Reunion Island (Indian Ocean) (5). Though Leptospirosis is reported throughout the year in Sri Lanka, two obvious peeks corresponding to the monsoon rain is observed annually (6). High humidity and heavy rain fall may play an important role in the spread of Leptospirosis in Sri Lanka, with heavy rains and floods attributed to the Leptospirosis outbreak witnessed during the paddy harvesting season in 2011 (6, 7). Reporting of Leptospirosis cases to Epidemiology Unit suggest a great variation between districts, signifying the importance of assessing the association of climatic factors with Leptospirosis incidence at district level (8).

This study was conducted to describe the association of selected climatic factors with district level incidence of Leptospirosis in Sri Lanka between 2008 and 2011. The factors selected were total monthly rainfall, monthly number of rainy days, mean monthly humidity and mean monthly temperature.

METHODOLOGY

A descriptive ecological study was carried out using district level Leptospirosis data and Meteorological Data. Monthly reporting of clinically confirmed Leptospirosis cases at district level was obtained from the Epidemiology Unit, Ministry of Health for years 2008 2011 and was used as the dependent variable. The meteorological data for 2008 2011 was obtained from the Department of Meteorology based on the metrological station. The total monthly rain fall, monthly number of rainy days, mean monthly humidity and mean monthly temperature were the four metrological parameters used as independent variables.

Based on availability of data at Meteorological stations, data could only be utilized to correspond to seventeen districts of Sri Lanka. The secondary data obtained from Epidemiology Unit and the Department of Meteorology were extracted from the relevant data sources and entered into a computerized data base. The selected districts were categorized in to three groups based on annual average incident rate of Leptospirosis as stated in global literature in to districts reporting high, moderate and low incidence of Leptospirosis (9). High, moderate and low incidence districts were categorized based on having an annual incidence rate of above 10, 1 10 and less than 1 case per 100,000 population respectively.

Data analysis was done using Statistical Package for Social Sciences (SPSS) 17th version. Pearson's Correlation Coefficient [r] was calculated to investigate the level of association between each of the independent variables and the district level monthly Leptospirosis incidence (dependant variable). P values of 0.05 or lower were considered to be significant. The transmission of the disease to the human from the environment, subsequent onset of symptoms and entering the hospital and reporting the cases by Medical Officer of Health (MOH) through weekly notification system takes approximately three to four weeks. Therefore the correlation was assessed between Leptospirosis incidence of a given month and the meteorological data of the same district for the previous month. Of the seventeen identified districts, the incidence of Leptospirosis cases was inadequate in the two districts with low incidence (less than 1 case per 100000 population), to make any meaningful correlation analysis.

The required data was obtained from the Epidemiology Unit, Ministry of Health and the Department of Meteorology with permission from Chief Epidemiologist and the Director General of Department of Meteorology respectively.

ANALYSIS AND RESULTS

Table 1: Annual Average Leptospirosis incidence rate in selected districts (2008 2011)

Category	District	Annual Average district Leptospirosis incidence rate (Per 100000 pop)
High incidence> 10 per100,000 population	Kurunegala	34.3
	Hambantota	28.4
	Ratnapura	23.5
	Galle	21.2
	Colombo	20.8
	Anuradhapura	16.9
	Gampaha	16.6
	Kandy	13.8
Moderate Incidence (1 10 per 100,000 population)	Puttalam	9.4
	Trincomalee	7.8
	Vavuniya	7.3
	Badulla	7.1
	NuwaraEliya	4.5
	Ampara	3.5
	Batticaloa	2.4
	Mannar	0.3
Low Incidence (<1 per 100,000 population)	Jaffna	0.1

A total number of 8, 7 and 2 districts were included in the High, moderate and low incidence category respectively (Table 1). Kurunegala had the highest annual incidence rate of Leptospirosis of 34.3 per 100000 populations. The lowest annual incidence was observed from Mannar (0.3/100000) and Jaffna (0.1/100000) districts respectively.

Table 2: Association between monthly incidence of Leptospirosis cases and selected climatic factors during 2008 2011in high incidence districts

District	Monthly total rainfall		Monthly total no of rainy days		Monthly mean temperature		Monthly mean humidity	
	Correlation [r]	P value	Correlation [r]	P value	Correlation [r]	P value	Correlation [r]	P value
Kurunegala	0.042	0.776	-0.033	0.823	-0.205	0.162	-0.274	0.059
Hambantota	0.077	0.601	-0.005	0.972	0.151	0.304	-0.333	0.021*
Ratnapura	0.360	0.012*	0.255	0.080	0.037	0.801	-0.278	0.056
Galle	0.100	0.498	0.149	0.312	-0.011	0.943	0.019	0.897
Colombo	-0.012	0.936	0.058	0.696	0.054	0.714	-0.042	0.776
Anuradhapura	0.427	0.003**	0.260	0.074	-0.333	0.021*	0.087	0.555
Gampaha	-0.011	0.939	-0.160	0.278	-0.127	0.391	-0.049	0.743
Kandy	0.020	0.895	0.002	0.989	0.078	0.600	0.321	0.026*

** significant at P<0.05 level*
***significant at P<0.01 level*

All four factors, namely the rainfall, rainy days, mean temperature and mean humidity does not show statistically significant correlation in general with Leptospirosis cases. However, majority of districts have shown a statistically non significant positive correlation for rainfall with Leptospirosis incidence. Significant positive correlation is seen only in Ratnapura and Anuradhapura districts for rainfall (Table2). Mean temperature and Leptospirosis incidence does not appear to have any direction of association as 50% of districts show a positive and 50% show a negative correlation. Only Anuradhapura district show a significant correlation. Humidity too appears to have mixed correlation with Leptospirosis cases.

Table 3: Association between monthly incidence of Leptospirosis cases and selected climatic factors during 2008 2011in moderate and low incidence districts

District	Monthly total rainfall		Monthly total no of rainy days		Monthly mean temperature		Monthly mean humidity	
	Correlation [r]	P value	Correlation [r]	P value	Correlation [r]	P value	Correlation [r]	P value
Puttalam	0.225	0.125	0.152	0.304	0.217	0.138	-0.092	-0.533
Trincomalee	0.097	0.512	0.001	0.992	-0.193	0.259	NA	NA
Vavuniya	0.082	0.581	0.026	0.862	0.065	0.661	-0.312	-0.310
Badulla	-0.399	0.005**	-0.434	0.002**	0.110	0.457	-0.302	0.037*
NuwaraEliya	-0.249	0.088	-0.182	0.216	-0.180	0.222	-0.128	0.387
Ampara	-0.144	0.328	-0.222	0.129	0.089	0.549	-0.156	0.291
Batticaloa	-0.124	0.402	-0.027	0.854	0.079	0.594	-0.197	0.181
Mannar	NA	NA	NA	NA	NA	NA	NA	NA
Jaffna	NA	NA	NA	NA	NA	NA	NA	NA

** significant at P<0.05 level*
***significant at P<0.01 level*

Except for Badulla district, which shows a significant negative correlation between rain associated factors (rainfall, rainy days) and Leptospirosis cases, there is no meaningful direction in correlation between Leptospirosis cases and rain (rainfall, rainy days). Three districts have a positive and four districts have a negative correlation with monthly rain fall and monthly rainy days. The association between mean temperature and humidity with Leptospirosis cases too does not give a clear direction in the seven districts with moderate Leptospirosis incidence. The monthly reporting of Leptospirosis cases from Mannar and Jaffna districts were too small to make any analysis.

DISCUSSION

In general, the present study did not find statistically significant correlation between climatic factors, namely the rainfall, rainy days, mean temperature and mean humidity with district level Leptospirosis incidence. However, the present study found a positive correlation between rainfall and incidence of Leptospirosis in majority of districts with high incidence of Leptospirosis, but the correlation was statistically significant only in two districts. One month lag was taken between Meteorological data and Leptospirosis cases for reasons explained in methodology. A study conducted in Reunion Islands found a significant positive correlation between Leptospirosis cases and monthly cumulated rainfall and the highest correlation found with average monthly rainfall recorded two months previously (5).A Study conducted in Thailand in 2003 2004 has found the cases to be predominantly identified following the rainy season in the north and northeast of Thailand (10). Positive correlation between Leptospirosis cases and rainfall is documented in other studies conducted globally (11, 12). The present study did not yield any meaningful correlation between Leptospirosis cases and rainfall in moderate and low incidence districts, though two districts in the high incidence districts showed a significant positive correlation. Hence the rainfall may play a more important role in Leptospirosis epidemics than the endemic transmission in Sri Lanka.

A Significant positive cross-correlation was detected between monthly cases of Leptospirosis and monthly minimum and maximum temperature recorded 0, 1 and 2 months previously in a study conducted in Reunion Island (5). However, temperature and humidity did not yield any meaningful association with Leptospirosis incidence in the present study. The results were similar in high incidence and moderate incidence districts. Sri Lanka being a hot and a humid country with minimum fluctuations in temperature and humidity throughout the year may be a reason for such a result.

The study was an ecological study conducted using available secondary data. Being an ecological study has its own advantages and limitations. Use of secondary data ensured the study was conducted rapidly and with minimum cost. However, the inherent limitations of ecological studies such as inability to link individual cases and inability to detect non linear associations between outcomes and risk factors need to be taken in to consideration. The results may have been affected by confounders and biases which cannot be eliminated through ecological studies. In general, the incidence of Leptospirosis and climatic factors did not yield a strong correlation at district level, though positive correlation between Leptospirosis cases and rain related factors were seen in some Leptospirosis high incidence districts. Such results would be valuable for district level health mangers in targeting effective disease control activities. Taking in to consideration the rainy seasons and anticipating out breaks following rainfall is important for district level disease control

activities. However, since this is an ecological study, further research is needed to test the study findings.

Acknowledgment: The authors acknowledge the valuable support given by Mr.S. H. Kariyawasam, Director General of Department of Meteorology.

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