SJIF Impact Factor (2025): 8.688| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 10 | Issue: 4 | April 2025 - Peer Reviewed Journal

INFLUENCE OF TEMPERATURE AND PRECIPITATION TO THE TRANSMISSION OF DENGUE AND LEPTOSPIROSIS IN THE KALUTARA DISTRICT OF SRI LANKA

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ABSTRACT

Dengue and Leptospirosis are the two highest reported, vector-bourne, notifiable diseases of Sri Lanka. Each accountable for over 200 deaths in 2024 with a mortality rate of 1.2% and 1.7% respectively.

Dengue virus is primarily transmitted to the human by the vector, Aedes aegypti mosquito which lays eggs in stagnant water whereas Leptospira virus transmitted through rodent urine and contaminated water.

Climate plays a major role in the epidemiology of vector-bourne diseases and so it should be a concern in prevention, especially in a country like Sri Lanka with year-round rainfall.

Objectives – Understand different geographical impediments in mitigating dengue and leptospirosis in Kalutara District Sri Lanka

Methods – Retrospective Descriptive study of the incidence of Dengue and Leptospirosis in Kalutara District of Sri Lanka which was evaluated against the climate variation of the country over the year.

Results – There's a crude decline of notified number of dengue cases and rapid rise of Leptospirosis cases in the Kalutara district associated with the periods of higher rainfall (September to December). Same pattern was identified in the national context as well.

Conclusion- Heavy rainfalls has contradictory effects on the epidemiology of dengue & leptospirosis. Heavy rainfalls wash away larvae of dengue vector mosquito which reduces the disease spread. They also causes heavy flooding which washes away leptospira vector rodents to reservoirs which increase the Leptospirosis transmission. Understanding this is important in planning the time frame for community based interventions to mitigate dengue and leptospirosis in Sri Lanka

KEYWORDS - *Dengue Leptospirosis Climate Epidemiology Kalutara*

CHAPTER 1
INTRODUCTION

1.1 Background

Dengue and Leptospirosis are two considerable viral infections affecting the population of Sri Lanka. They acconts for the highest incident notifiable diseases of Sri Lanka. As of the Weekly Epidemiological Reports of Sri Lanka, they are the highest counted viral infections which accounts for over 200 deaths in 2024 with a mortality rate of 1.2% and 1.7% respectively.

Dengue virus mainly transmits by infected *Aedes aegypti* and *Aedes albopictus* mosquitos. It also could be transmitted from pregnant mother to fetus via the placenta and through blood transfusion and organ transplantation as well. Still the vector-bournse transmission remains the most significant mode of Dengue transmission.

Thereby the direct influence of weather and climate to the life-cycle of the vector makes Dengue transmission more cyclic and climate dependant. Temperature affects dengue transmission by influencing the biting patterns, incubation period and thereby the reproduction rate. Rainfall in the other hand affects the mosquito breeding sites, which could affect positively as well as negatively. Some studies shows increased precipitation leads to increased mosquito breeding sites which ultimately increases the chance of those vectors to obtain the pathogen and transmit. Whereas some studies demonstrates that increased rain leads to extinguish stagnant water which ultimately leads to reduced Dengue Incidence.

Alternatively a recent study in the Philippines indicated that rainfall increases the incidence of Dengue in the Eastern region and increased rainfall in the Western regions repressed the Dengue incidence.

Leptospirosis is common zoonotic disease caused by a spirochete *Leptospira*. It has a clinical spectrum from simple flu-like illness to worse systemic complications leading to multiorgan failure and death. It commonly transmits through direct or indirect contact with infected animal urine where the animal may or may not show any features of infection. Indirect spread occurs with contact to the contaminated water from the infected animal / rodent urine.

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Previous studies shows there is an increased number of Leptospirosis cases associated with increased rainfall due to washing away of leptospira infected rodent/animal urine to the streams / paddy fields and water.

Climate plays a major role in the epidemiology of vector-bourne diseases and so it should be a concern in prevention, especially in a country like Sri Lanka with year-round rainfall.

Thereby this study aims to identify the influence of temperature and precipitation to the transmission of dengue and leptospirosis in the Kalutara district of Sri Lanka.

1.2 Objectives

General Objective

Understand the influence of temperature and precipitation to the transmission of dengue and leptospirosis in the Kalutara district of Sri Lanka

Specific Objectives

1. To identify the pattern in the incidence of Dengue & Leptospirosis cases within the year of 2024 in Sri Lanka
2. To identify the pattern in the incidence of Dengue & Leptospirosis cases within the year of 2024 in the Kalutara District of Sri Lanka
3. To identify the temperature and the precipitation patterns in Sri Lanka over the year 2024
4. To identify the temperature and the precipitation patterns in the Kalutara District Sri Lanka over the year 2024
5. To identify the tendency of the disease spread of Dengue & Leptospirosis against the precipitation and the rainfall of Sri Lanka as well within the Kalutara district.
6. To identiyfy the factors influencing the epidemiological variations of Dengue and Leptospirosis over the year 2024

CHAPTER 2
METHODOLOGY

As of the international standards, Sri Lanka is highly compliant with communicable disease surveillance. There are identified notifiable communicable diseases in the country which has to be notified to the Regional Epidemiologist & the Central Epidemiology Unit through Medical Officer of Health in the area. Central Epidemiology Unit publishes a Weekly Epidemiological Report.

Weekly Epidemiological Report is a weekly bulletin with updates on communicable disease outbreaks and relevant statistics for the public health interest. It weekly elaborates statistics on notifiable communicable diseases in each district.

This includes the district-wise incidence of Dengue Fever, Dysentery, Encephalitis, Enteric Fever, Food Poisoning, Leptospirosis, Typhus Fever, Viral Hepatitis, Human Rabies, Chickenpox, Meningitis, Leishmania, Tuberculosis and vaccine preventable infections.

The weekly epidemiological data with respect to Dengue and Leptospirosis were extract for the 52 weeks of the year of 2024 and analyzed against the weather statistics of Sri Lanka.

2.1 Study Design

Descriptive Study based on the retrospective data from January 2024 to December 2024

2.2 Data Analysis

Data analysis was done using Statistical Package for Social Sciences (SPSS) and Microsoft Excel. A descriptive statistical analysis was done and is presented in the form of tables, diagrams, and graphs where necessary.

CHAPTER 3
RESULTS

A significant number of Dengue and Leptospirosis has been reported throughout the year 2024 in Sri Lanka as well as in the Kalutara District.

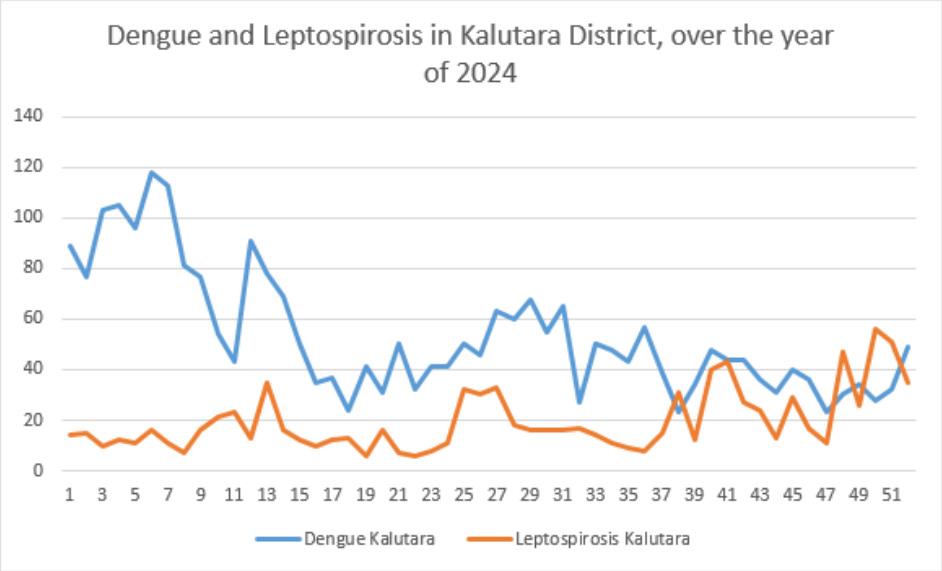
Highest number of Dengue cases in the Kalutara District was noted in the 6th week of 2024 (February) (118) and lowest number of cases were noted in the 38th week (23), September 224. Whereas highest number of Leptospirosis cases were noted in the 50th week (56) December and the lowest cases were reported in the 19th week (6)

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Dengue has a spike in the early year 2024 in the Kalutara District, peak from January to February with the rapid decline in the later part of the 1st trimester (17-23 weeks). Theres another increasing number of cases within the rest of the year with a platueu phase with a significant deline towards the later part of the year.

Reported number of Leptospirosis cases bears a lower baseline trend in the beginning of the year (1st quater) with a plateu like spike towards the later part of the year peaking towards the end of the year.

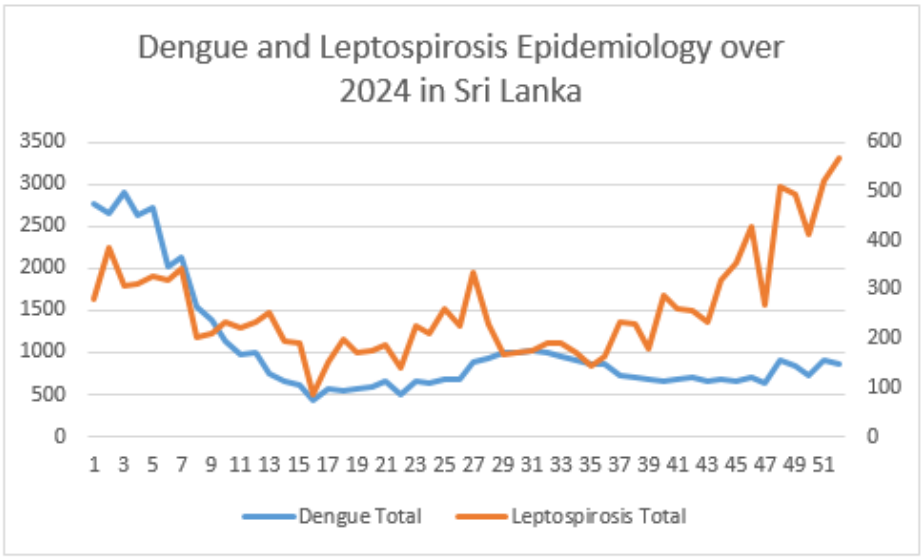
Despite the wide disparity in the number of cases between Dengue and Leptosoirosis within the year 2024, the trends of incidence bears a counter trend towards each other



Island wide statistics of the same also bears a similar trend with Dengue and Leptospirosis with significantly highlighted inverse association.

Recorded highest number of Dengue cases were noted in the 3rd week (January) with an average of 1,989.5 cases per week during the 1st quarter. Whereas only 748.3 average number of cases were reported per month on the last quarter of the year in 2024. This shows a 37% decline of the reported cases from early 2024 to late 2024.

Even with crude fluctuations, total number of Leptospirosis cases reported in Sri Lanka remains static throughout the 1st 3 quaters of the year with a significant spike towards the last quarter.

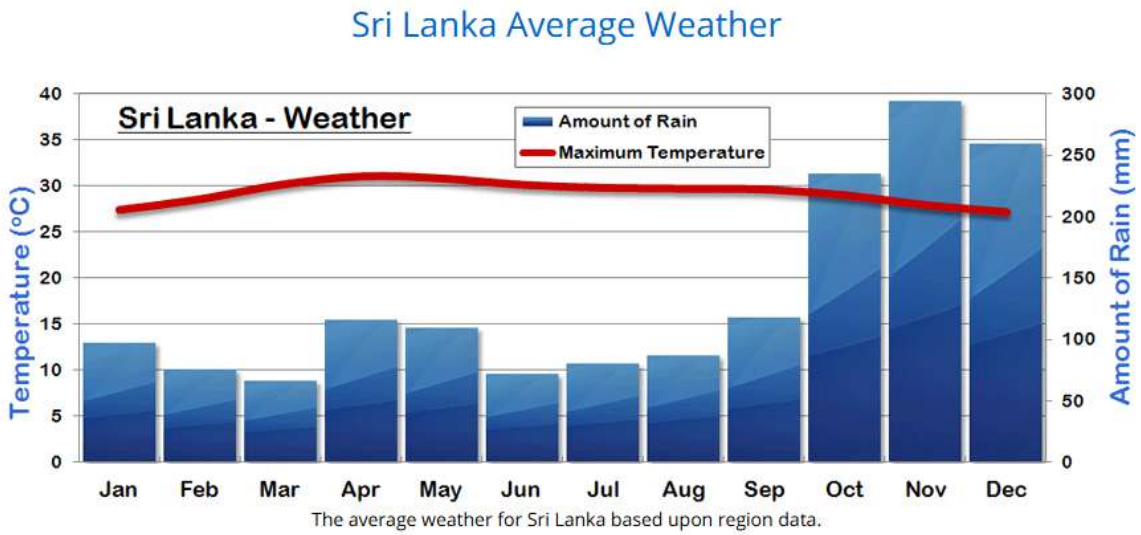


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Thereby the Kalutara region wise and Island wide trending shows an inverse association between the reported number of Dengue cases and Leptospirosis cases with a notable decline of Dengue cases and rise of Leptospirosis cases towards the last quarter.

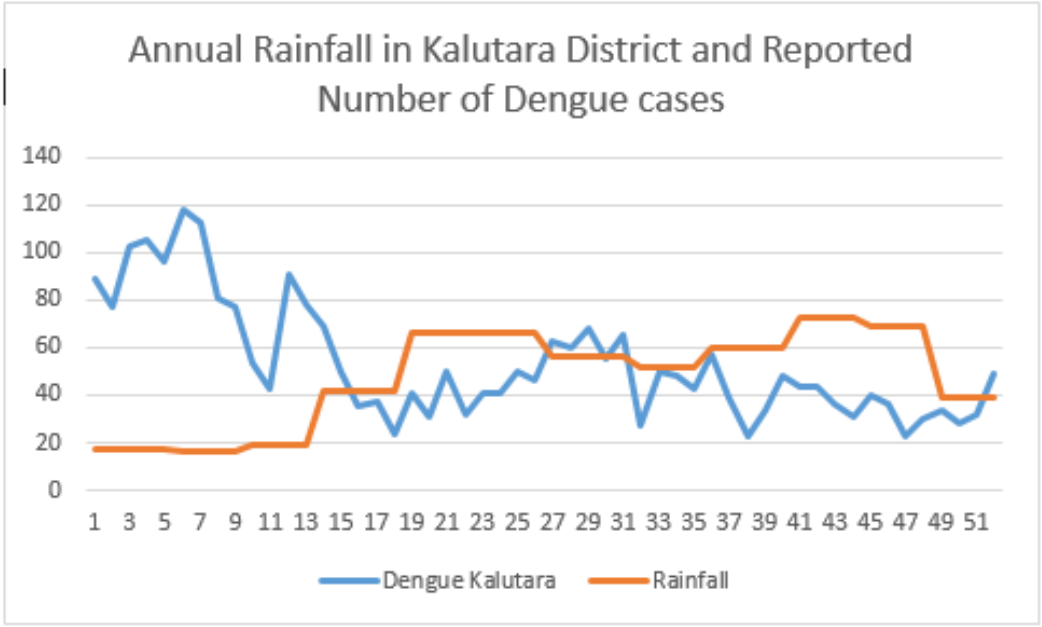
There are significant geo-socio-epidemiological causes behind this trend and the fluctuation, but it's important to analyze the trend of weather – specially the temperature and the rainfall during the year 2024 to understand any co-relations.

When carefully analyzing the rainfall trend of Sri Lanka within 2024, it's obvious that the island received its highest rainfall during the last quarter of the year which almost doubles the baseline rainfall for the rest of the year.



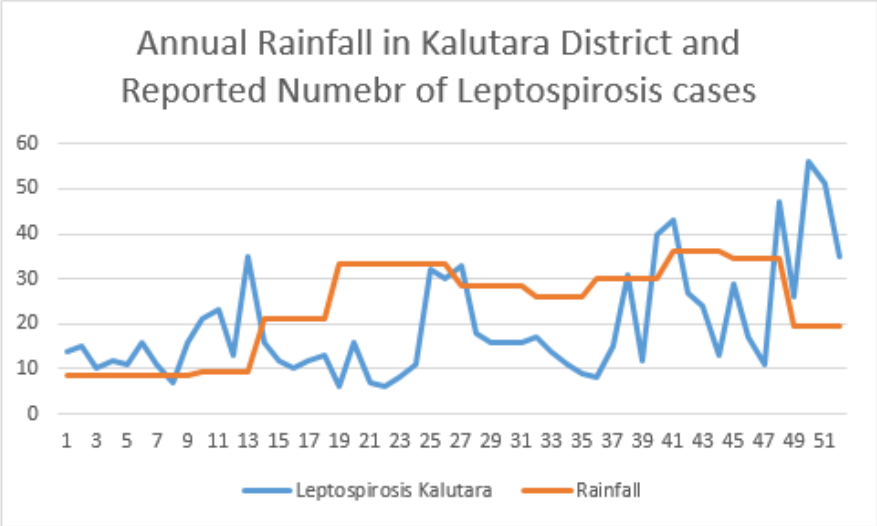
Therefore it's important to determine the correlation between the increased number of reported Leptospirosis cases, decreased number of reported Dengue cases and the increased rainfall during the last quarter of 2024

Thereby the Annual Rainfall received by the Kalutara District was analyzed against the reported number of Dengue cases within the Kalutara District by the year 2024. Average Monthly Precipitation Levels were extracted from the Global climate and weather information related to the district. Average monthly rainfall was calculated from precipitate levels from each month.



A significant correlation was identified within the rainfall of Kalutara District and the reported number of Dengue cases. Within the first trimester of 2024, significant reduction of the rainfall was noted, along with reported higher number of cases. With the middle trimester and the last trimester the rainfall and the reported cases were fluctuating with higher rainfall and lower reported cases.

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Similarly yet direct relationship was noted with the rainfall and the reported number of Leptospirosis cases within 2024 at Kalutara district. This was notably indicated specially in the 1st trimester where there was a reduced number of reported Leptospirosis cases as well as lower level of precipitation. Likewise, a higher number of cases were noted in the later part of the year 2024 along with a significantly high preicipitation.

CHAPTER 4
DISCUSSION AND LIMITATIONS

Discussion

Dengue and Leptospirosis bears a significant disease burden to the Healthcare systems and the economies of the South Asian Region, including Sri Lanka. Thereby it's important to identify the epidemiology of them in order to mitigate those vector-bourne diseases.

As of the analyzed data, geographical impediments such as temperature and rainfall plays a major role in the epidemiology. One of the significant factor identified and analyzed here is the annual rainfall and how it affect the disease spread.

Despite the Geo-climatic factors as above there are various other direct influencers of the disease spread. This includes and not limited to population behavior and exposure patterns, vector control mechanism and their efficacy, temporary human immunity and many more.

The climate pattern of Sri Lanka as a whole has differences with the selected Kalutara District which may leads to impairment in exact comparison of the incidence patters of Dengue and Leptospirosis

There are micro, grassroot level as well as region-wise mosquito eradication programs, information sessions and similler community based interventions occur which may leads to the fluctuation of the incidence

Also another significant factor which includes interference with the statistics is mis-diagnosis and mis-interpretation in surveillance. Especially since both diseases shares similar clinical features.

Limitations

1. The confounding variables as discussed above (population behavior and exposure patterns, vector control mechanism and their efficacy, temporary human immunity, community interventions) leads to altered disease incidence in Dengue as well as in Leptospirosis.
2. There are significant number of subclinical and unreported cases as well as misclassification of diseases which affect the incidences
3. Study depends on the secondary data of the Sri Lankan WER based and international weather information
4. There are public health community based vector control interventions which may leads to misrepresentation of actual data.
5. Infections can lead to herd immunity in the community which is beyond the limitation of this study

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CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the analsysis, dengue and leptospirosis has different epidemiological effects from cyclic changes in precipitation and temperature in Sri Lanka as well as in the context of Kalutara district.

Similarly as of the statistics of Sri Lanka as a whole and in the region of Kalutara District, heavy rainfalls and decreased temperature leads to increased number of Leptospirosis cases and decreased number of Dengue cases.

When understanding the pathophysiology and the lifecycle of the Aedes egyptyi and the Dengue vector, heavy rainfalls wash away the larvae of the vectors. This obstructs the lifecycle of the vector which could ultimately breaks the chain of new vector formation.

Reduction of vectors directly acts on the disease spread and the number of cases.
But in the other hand heavy rainfalls wash away the leptospira vector rodent's wastes. This wash away leads to accumulation of leptospira in the streams, stagnent water and specially the paddy fields. This goes hand in hand with the peak 'Maha Season' of Sri Lankan paddy field crops.

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