Dengue - Identifying the Disease Pattern in Sri Lanka

K. A. D. S. Chandrasiri

Postgraduate Institute of Humanities and Social Sciences
University of Peradeniya, Sri Lanka

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Introduction

Dengue is a vector borne arbo viral disease and it is transmitted by two mosquito species namely *Aedes aegyptii* and *Aedes albopictus*. Dengue virus is named as DENV and it belongs to the *genus flavivirus* in *family flaviviridae.* It has 4 antigenically different serotypes, DENV1, DENV2, DENV3, and DENV4. Infection with a single DENV serotype leads to long-term immunity against that particular serotype, however, not against the other serotypes. Therefore, prior infection with a single serotype of DENV only provides a homotypic protection (Sirisena 2013).

All serotypes of DENV have been seen in Sri Lanka for more than five decades and their distribution has not changed significantly in the last 30 years. Although the Sri Lankan population had been exposed to DENV for a long time, the severe forms of DENV infection (DHF and dengue shock syndrome (DSS)) were very rare before 1989. There was an island-wide epidemic of DF associated with DENV serotypes 1 and 2 from 1965 to 1968. This epidemic caused 51 DHF cases and 15 deaths.5 DENV-1 and DENV-2 were isolated from the outbreaks in 1965 and 1966 (Sirisena 2013).

The disease is seen in tropical countries and the burden of disease has increased by 30-fold over the past 50 years (Ebi 2016). By 2017, this is the most concerned public health issue in Sri Lanka. The reported numbers of cases have increased gradually and the increment is

840.5 % since 2002 through 2016. There are various numbers of reasons for this including urbanization, climate change, and poor waste management. 57 years have passed since Sri Lanka started to experience Dengue but 2017 is the year that recorded the highest numbers of patients and it's only for 6 months.

Numbers of studies have already been undertaken to investigate the various aspects of the link between climate change and the spread of dengue fever in different countries Rigau-Perez et al. (1998) observed that high humidity is favorable for increased dengue disease transmission, hatching and activities of mosquito vectors. According to findings of Tun - Lin et al. (2000) development rates of Aedes aegpti eggs, larvae, pupae, increased with increased temperature. Their findings are similar to observations of Rueda et al. (1990). Cyclical nature and seasonal increase of dengue disease was studied Reiter (2001) and he found a condition between climatic changes and disease occurrence. It is clear that dengue transmission is influenced by several factors related to households, individual and environmental. Similar findings were made by Hoeck et al. (2003) who observed that monsoon rains in neighborhood areas increased the population of mosquitoes. According to Sukri et al. (2003) as well as Wilder - Smith and Gubler (2008) ideal conditions for dengue fever transmission were stated to be enhanced by high population density of both humans and mosquitoes. While Siqueira-Junior et al. (2008) reported that spatial distribution of dengue cases depended on the community status of individuals, additional factors such as demographic density, population motility and sanitation contributed to the spread of mosquitoes and dengue incidence.

The above review of the previous studies shows that these studies have only provided limited information on the disease pattern. Accordingly, it is obvious that more conceptual and theoretical work is needed to develop a better understanding of this field.

Objectives

The objective of this study is to analyze the seasonal pattern of Dengue in Sri Lanka. There are numbers of diseases which show seasonal pattern ranging from childhood diseases such as measles, chicken pox and faeco-oral infections to vector-borne diseases such as Leptospirosis and Dengue (Grassly et al. 2006). Only a few numbers of research papers could be found on this subject. Therefore, it is important to study the epidemiological dynamics of a disease in terms of planning control strategies.

Methodology

Nationally accepted data on reported dengue cases and population were used as secondary data in this study. As far as the data on Dengue reported cases are concerned, monthly as well as biweekly reported numbers were used and they were categorized based on districts and MOH (Medical Officer of Health) areas. The data were analyzed using Excel to evaluate the spatial distribution and the relationship with population variables. Various charts and graphs are used to describe the relationships between variables as well as the disease prevalence across the year and districts.

This study used two type of data. They are reported dengue cases and population data. The data on reported dengue cases used in this article were retrieved from the information published by the Epidemiology unit of Sri Lanka ministry of health. Those are freely available in their official website(www.epid.gov.lk). Population data which are used while preparing this article were taken from the official website of the Department of census and statistics of Sri Lanka (www.statistics.gov.lk). The data on reported dengue cases from January 2002 to June 2017 were used to analyse of this study.

Results and Discussion

Dengue fever is an infectious tropical disease caused by the dengue virus and it is transmitted by several species of mosquito that breed under different climate situations(Athukorala, 2016). Infection with a different type increases the risk and there is no available vaccine, to prevention reducing the habitat and the number of mosquitoes and limiting exposure to bites. According to the WHO report (2012) approximately 2.5 billion people, two fifths of the world's population is now at risk from dengue and estimates that there may be 50 million cases of dengue infection worldwide every year. The disease is now endemic in more than 100 countries.

As far as the reported dengue cases since 2002 in Sri Lanka are concerned, it is noteworthy that there is an increasing trend over the time. There were 8,931 cases in 2002 and it was increased up to 55,150 by 2016. The difference is 46,219 and it was 517.5 % increment. More steep increment is observed in 2009 and it was 35,095 cases island's cumulative. The dengue cases were increased by 20,055 and the increment is 57.14 % from 2009 to 2016. More intensive increment can be observed from 2009 to 2016 and more in 2017 making cumulative cases 83,997 only till June.

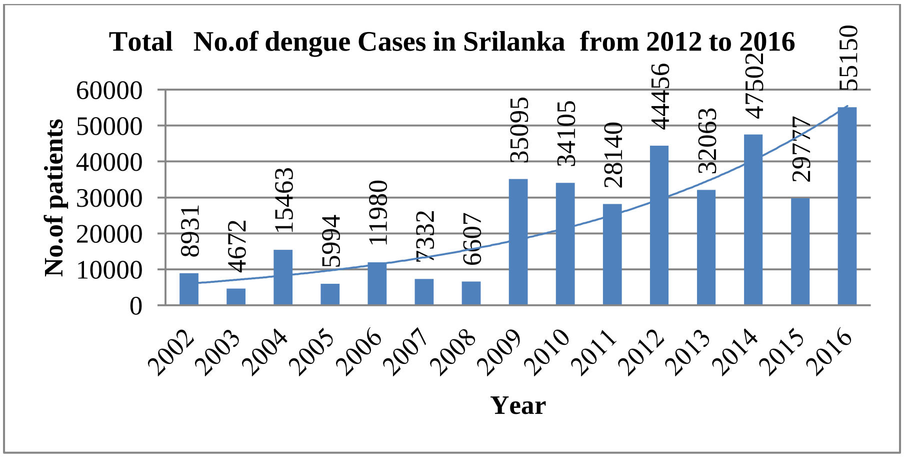

Figure 1: Reported Dengue cases in Sri Lanka 2012 - 2016

There is distinctive pattern of dengue disease throughout the year. This is generally equal in almost every year. There are two dengue case peaks in a year while no zero case months. One peak is in June/ July while other peak is in December/ January. This characteristic “W" pattern is evidenced in every year from 2012 and this is clearly seen in monthly average of dengue cases in Sri Lanka. The height of the peaks is becoming increased over the years. Usually the middle year peak is higher than the early/end year peak but this pattern was differed in 2013 and 2015 making the early/end year peak higher. There is a slight difference of peak month between months in district level case analysis. But the general pattern can be observed in almost all districts.

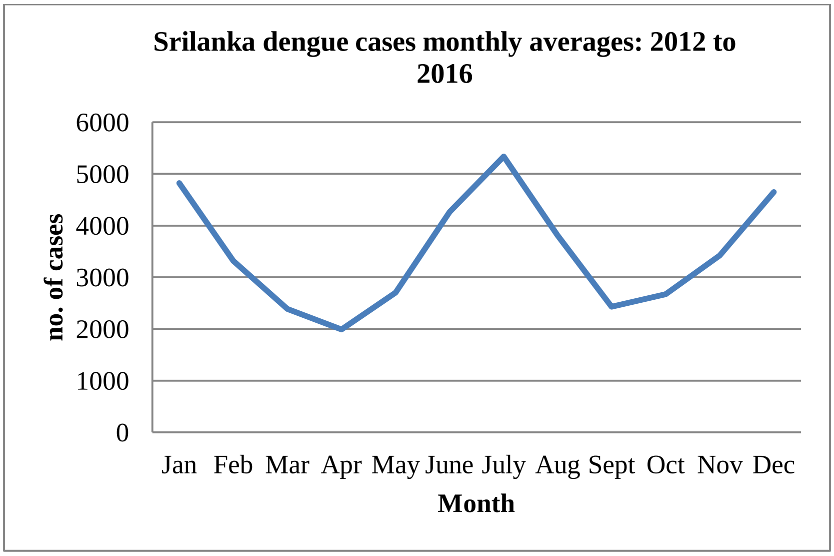

Figure 2: Distinctive **W** pattern: 2012 to 2016

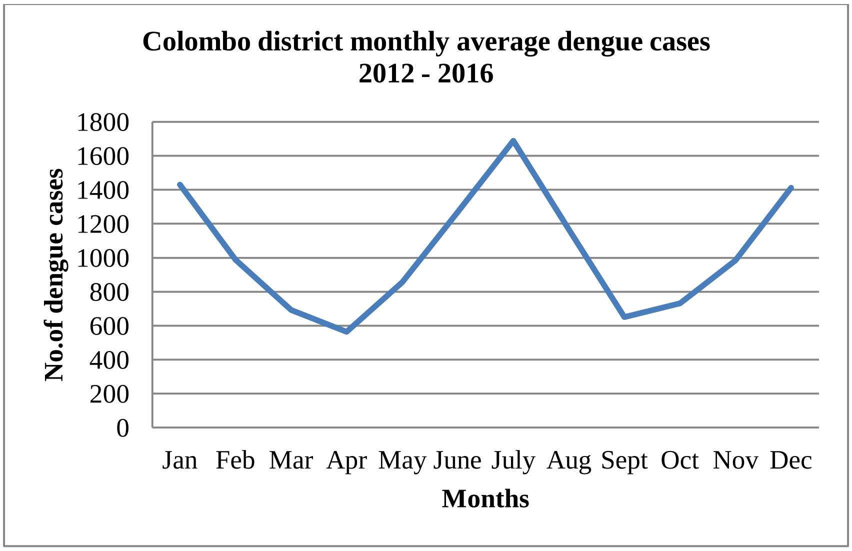

Figure 3: Monthly average dengue cases from 2012 to 2016 in Colombo district.

The cause for this phenomenon might include several factors including climate change and the virulence of the causative agent. More researches are needed to solve this problem. There is a strong relationship between cumulative dengue cases and population density in district level analysis. Every year, Colombo district records the highest numbers of cases and it has a population density of 3330 people's per km^2 in 2001 census which is the highest of the island. Interestingly this trend can be observed in every district.

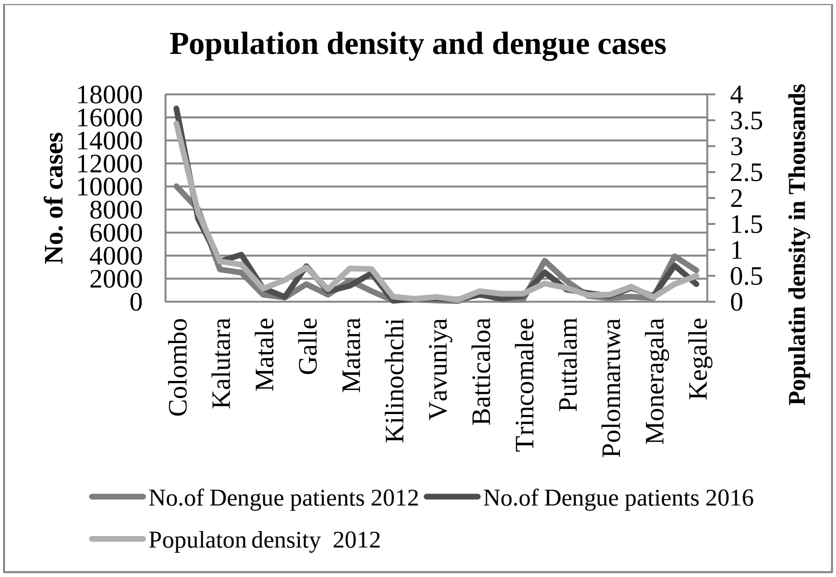

Figure 4: The relationship between population density and the prevalence of dengue cases in district level

Conclusion and Policy Implications

Dengue represented a significant economic burden on the communities. It can result in loss of lives, considerable expenses to the family for the hospitalization and care of the patient, in addition to travel costs, loss of work among patients and their career, considerable expenses to ministry of health and local government authorities for mosquito control activities and disruption of health care services and economics, including loss of tourism revenue. Government in Sri Lanka allocate over Rs. 300 million as the direct cost of control measures for dengue in each year.

Dengue has a distinctive disease pattern over the time. This is similar in almost every year. Characteristic " W " pattern is observed with two peaks. There is a strong relationship between dengue numbers of cases and population density in district level. Reason for these characteristics should be analyzed furthermore and more research are needed.

According to the result of this study it is clear that the selection of high risk areas for dengue transmission should be based on population density rather than the reported numbers of cases. A threshold value should be assigned in terms of risk area selection and it will be helpful in dengue prevention programs. The threshold values can be decided up to Divisional secretariat level and it needs more expertise researches.

A study of this nature helps develop a program for changing peoples' behavior with the changes of climate in any country while minimizing the social cost of climate change. The overall findings of this research will help implement policies to reduce spread of dengue related diseases that is increasingly posing a major challenge in the health sector in the country. The results of the study will provide an opportunity to make necessary policies that provide incentives to reduce of spreading dengue related diseases at the household and district level which generate regional as well as global benefits in the future.

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