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Identification of the patterns of dengue disease transmission: A Wavelet approach

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Dengue is transmitted over the human population by the mosquitoes *Aedes aegypti* and *Aedes albopictus.* This comes in three forms: Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS). Sri Lanka has been suffered by dengue fever and DHF epidemics for over two decades and now the risk has been increased rapidly mainly in urban areas. In the context of Sri Lanka, during 2017, 186101 dengue cases have been reported from all over the island and approximately 35.2% of dengue cases were reported from the Western province. In the past few decades, many studies on vector control, the molecular biology of the virus, vaccine development and the pathogenesis of dengue hemorrhagic fever/dengue shock syndrome have been conducted. But comparatively, little effort has been directed towards identifying patterns of dengue transmission. That is because of dengue transmission mechanism is complex as it is based on several external factors such as climate, geography and human mobility. The main objective of this study is to focus on identification of Dengue disease transmission patterns in Colombo area using wavelet transformation. Particularly, the study focuses on identification of periodicity of outbreaks of dengue data and their frequency and intensity. Further to analyze the El Niño effect on dengue cases in Colombo area and to describe the impact of climatic factors such as rainfall and temperature. Wavelet analysis has been used to identify the patterns of dengue transmission. It is a powerful mathematical tool, which performs time-frequency decomposition of the signals, and estimates the spectral characteristics as a function of time. Cross-wavelet transform and wavelet coherence will be used to examine relationships in time-frequency space between two-time series. The wavelet power spectrum was obtained from weekly reported dengue cases in Colombo from 2006 to 2017, and significant regions were observed in the spectrum corresponding to approximately 26 week cycles during mid of 2014 to 2017. The cross wavelet power spectrum revealed that there is a similar strong link between how rainfall and temperatures resulting from the reoccurring El Niño phenomenon are associated with elevated risks of dengue epidemics from 2010 to 2012 and 2015 to 2017. Further using cross wavelet power spectrums, it was observed that to develop a prediction model for dengue transmission, rainfall and minimum temperature play a major role.

Keywords: Dengue disease, El Niño, Wavelet