Abstract No: PO-03

A mathematical model to analyze the dynamics of Dengue transmission: A case study based on Western Province, Sri Lanka.

D. H. V. Gammune* and L. P. N. D. Premarathna

Department of Mathematics, University of Kelaniya, Sri Lanka
*hasinigammune@gmail.com

Dengue fever, which is a rapidly spreading mosquito-borne viral disease, has become a major public health problem in the world, including Sri Lanka. The Western Province of Sri Lanka has been experiencing a very high number of Dengue incidences throughout the past few decades. According to literature, considerations have not been paid on the dynamics of Dengue transmission and interplay of climate changes with mosquito biting rates. Therefore, a mathematical model is to be introduced to integrate the behavior of the climate changes as well as the mosquito biting rates with the dynamics of dengue transmission. Dengue is transmitted only through the bites of the infected mosquitoes, and the number of mosquito bites during a certain period is directly proportional with the number of Dengue cases reported during the same period. The aims of the research are, therefore, to identify the behavior of the climate factors on the dynamics of Dengue transmission, to develop a mathematical model to analyze the dynamics of spread of Dengue and to predict the future Dengue outbreaks of the Western province of Sri Lanka, using the developed model. Since the climate variables play a greater role in Dengue transmission, the correlation between the number of Dengue incidences and the climatic variables is analyzed. The vector-borne compartmental models have been used in the literature to understand the dynamics of different types of epidemic diseases. Hence, in this study, a similar approach is used to analyze the Dengue transmission, which considers the influences of climate changes on the Dengue transmission dynamics via the time-varying mosquito biting rate. A significant positive correlation is found between the reported number of Dengue incidences and the average temperature. According to the analysis, the developed model, together with the estimated mosquito biting rates, gives a statistically significant goodness of fit between the simulation results and the reported number of Dengue incidences. The analysis highlights that the dynamics of Dengue transmission are less sensitive to the variation in the mosquito population size than the changes in the mosquito-biting rate. The proposed model is validated by comparing the predictions with the data, which are not used in the model calibration. The model validation exhibits that there is a statistically significant fit between the model predictions and the actual data. The proposed vector-borne compartmental model along with the estimated mosquito biting rates, therefore, can be used to predict the dynamics of Dengue transmission with a high accuracy.

Keywords: Dengue fever, Correlation, Vector-borne compartmental model, Mosquito biting rate, Climate factors.