

## Correspondence

### **An analysis on model development for climatic factors influencing prediction of dengue incidences in urban cities**

Sir,

The article by Karim *et al*<sup>1</sup> on climatic factors influencing dengue cases in Dhaka city, a model for dengue prediction is timely, and has dealt with a conceptual framework for constructing and evaluating climate-based Early Warning System (EWS). In 2004, the World Health Organization<sup>2</sup> prepared guidelines for the Department of Communicable Diseases Surveillance and Response (CSR), Department of Protection of Human Environment (PHE) and the Roll Back Malaria to predict infectious diseases wherein a few salient features were identified, namely (i) strengthening long-term disease surveillance system for timely model development, (ii) utilizing relevant criteria and technology for evaluating model accuracy, (iii) interpretation of non-climatic factors, and (iv) an access to help policy makers for a particular need and response decision.

The author<sup>1</sup> have developed three models for data analysis, model development and validation where independence of data point was checked through Durbin-Watson estimate but choosing monthly rainfall (mm), humidity (%), and temperature (°C) (minimum and maximum) as independent variables with monthly dengue cases as dependent variable. They could have considered other monthly vector indices also, *viz.* vector density, their extrinsic incubation period and gonotrophic cycle length along with other three climate parameters as independent variables. Weather-driven transmission dynamics and its assessment is related to two important insights central to the development of mathematical dengue epidemiology<sup>3</sup>, (i) the mass action potential: dependent rate contact between susceptible host and infectious vectors and (ii) threshold theory that limits vectors exceeding certain critical level for the transmission to occur. It has been reported that these insights established two weather-driven

models (Container-inhabiting mosquito simulation model CIMSiM and Dengue simulation model DENSiM) used to elucidate non-linear relationship influencing activity in dengue system which have not been considered while developing the models by the present authors. In discussion only the role of multiple serotypes, immune-mediated serotype interactions and environmental variations has been mentioned, but none of the parameters for studying vectors have been discussed for the period extending 2000-2009. The aetiology of antibody-dependent negative and positive strain interactions during the inter-epidemic periods of 0-5 years has not been corroborated with age-stratified seropositive data in which the force of infection was reported to vary over a 3-4 year period<sup>4</sup>. Further, two possible causes of between-year epidemic events have been reported, (i) extrinsic- El Nino phase of Southern Oscillation (ENSO) type<sup>5</sup> climate phenomenon and, (ii) intrinsic-associated with host-pathogen dynamics. At this point of assessment, it was pertinent to assess the aetiology of inter-epidemic periods and the relative importance of intrinsic and extrinsic influences which has not been done in climate predictive early warning model. This situation also persisted in 2003 and relevant parameters were not taken into consideration to understand the status of infectious vectors and susceptible host in such urban settings.

In this study<sup>1</sup>, the dengue case data have been collected from the hospitals for analysis for model development but to validate their basic indices, serotyping was essential. During the 9-year study period, 22,705 dengue cases were passively recorded without clinical diagnosis. Global Surveillance on dengue and DHF in WHO-managed Dengue- Net collects and analyse case data from participating countries/partner. In a climatic prediction model the possible of DHF and DSS cases, if any is essential to assess the disease burden *vis-à-vis*

emergency preparedness predictive to identify serotype prevalence (acquired elsewhere) in climate prediction model. Bangladesh is a close neighbour to other South-East Asian countries namely India, Myanmar and Thailand where migration is a regular feature of local habitats in bordering countries.

The basic demography of patients during a 9-year period suffering from dengue infestation could have been identified the particular area(s)/location(s), age-specific stratification, role of specific vectors (*i.e. Aedes aegypti*) and their development. Survival rates of vectors are basically the functions of temperature and atmospheric moisture (saturation deficit) usually used to interpret certain weather-driven ENSO influences<sup>5</sup>, a factor enhances dengue cases in Dhaka City. This has been mentioned here because humidity has a significant role of increasing the trend of dengue outbreaks two months prior to outbreak and two months ahead of that.

In retrospective model validation, the result showed that in 2003 the predicted and observed number were not correlated significantly, because the cases were less. The demography of the area-specific vector indices with serotyping of person infected in previous two years *i.e.* 2001 and 2002 and similarly after two years it was essential to understand DENV viral propagation in a spatio-temporal phylogeny mode<sup>6</sup>. This would have disclosed the viral propagation, introduction time, evolution pattern in densely populated urban settings of Dhaka city. The authors have cited studies from India and Thailand but certain field-based pilot experiments with vectors and serotyping in endemic area were essential to correlate these appropriately to reflect the area specific prevalence of weather-driven incidences as pointed out in the discussion.

Of the three retrospective models, only model 3 showed 61 per cent variations in case occurrences with significant correlation observed with the predicted and the observed number in only three years, *i.e.*, 2001, 2005 and 2008, but not in other 5 years except 2003 for which an explanation is required. In such a situation, time-series techniques of spectral density analysis (SDA) would have been used to correlate their periodicity in both the epidemiological and meteorological data (ENSO) after availing the vector indices<sup>3</sup>. While making use of the SDA model between the years epidemic events, extrinsics associated with ENSO-type climate phenomenon and intrinsics associated with host pathogen population dynamics

could have been made possible. In this situation, it is essential to assess the aetiology of inter-epidemic periods and the importance of intrinsic and extrinsic influences to develop an EWS for disease epidemics, because there is a dynamic interaction between host and parasite/pathogen populations. In epidemiological in Susceptible, Exposed, Infections, Recorded (SEIR) unforced models of directly transmitted diseases are predicted to exhibit damped oscillations with an appropriate inter-epidemic periods. It has also been reported<sup>4</sup> that inter-epidemic period is determined by climate conditions at least for the vector-borne diseases where intrinsic population dynamic processes offer most parsimonious explanation of dengue incidences where epidemiological models combining within-year extrinsic and between-year intrinsic determinants of mosquito-borne disease incidence for epidemic prediction should be an amenable platform of climate-based incidence prediction.

**P.K. Kar & S.K. Ghosh\***

National Institute of Malaria Research  
NIMR Unit, ICMR Complex  
Devanahalli, Bangalore 562 110, India

*\*For correspondence:*  
ghoshnimr@gmail.com

### References

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