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Predicted pattern of Zika virus infection distribution with reference to rainfall in Thailand

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ABSTRACT

Zika virus infection is the present global medical problem. The disease appears in several countries around the world. The relationship between rainfall and occurrence of Zika virus infection was previously mentioned. Here, the authors use the mathematical modeling technique to reappraise on the previous data on immunoreactivity rate of Zika virus, dengue virus and Ckikungunya virus in Thailand and the reported interrelationship between arboviral infections and rainfall in Thailand for constructing of the predicted pattern of Zika virus distribution in Thailand. This data can be a useful tool for further disease surveillance in this area.

1. Introduction

Zika virus infection is the present global medical problem [1–3]. The disease can cause dengue-like illness and the infection in the pregnant can result in congenital anomaly [1–3]. At present, this disease appears in several countries around the world with the significant number of infections in tropical countries in South America [1–3]. As a mosquito borne infection, the effect of climate on this infection is mentioned. The relationship between rainfall and occurrence of Zika virus infection was previously noted [4].

Here, the authors use the mathematical modeling technique to reappraise on the previous data on immunoreactivity rate of Zika virus, dengue virus and Ckikungunya virus in Thailand and the reported interrelationship between arboviral infections and rainfall in Thailand for constructing of the predicted pattern of Zika virus distribution in Thailand.

2. Materials and methods

2.1. Previous data in Thailand

The main previous data used for the present study refer to the previous publications. The previous publication I Asian Pac J Trop Med by Wikan *et al.* is used for referencing to immunoreactivity rate of Zika virus infection, dengue virus and Cikikungunya virus in Thailand [5]. The other two publications [6,7] on reported interrelationship between arboviral infections and rainfall in Thailand are also used as basic data for modeling in the present study.

2.2. Mathematical modeling

The mathematical modeling technique is used for generating of the predicted pattern of Zika virus infection distribution with reference to rainfall in Thailand. First, the predicted rates of Zika virus infection relating to the other two common arboviral infections in Thailand, dengue virus and Ckikungunya virus, were calculated based on the data in the report by Wikan *et al.* [5]. The derived rates were used for further adjustment to the previously reported equations on interrelationship between arboviralinfection rate, prevalence, and rainfall in the previous referencing report [6,7]. Summarization of the derived equation into the final equation for predicting the prevalence of Zika virus infection pattern relating to rainfall in Thailand was done.

3. Results

3.1. Primary basic data

According to the report by Wikan *et al.* [5], it can be calculated that the rate of concomitant Zika virus

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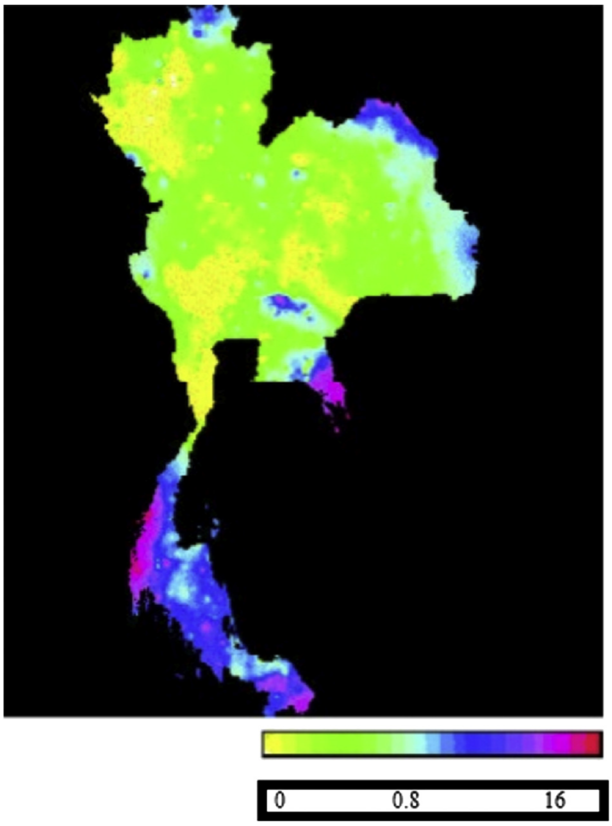

Figure 1. Predicted prevalence (case/100 000 population) of Zika virus infection in Thailand.

immunoreactivity in cases with dengue virus immunoreactivity and Ckikungunya virus immunoreactivity is equal to 13/17 (76.47%) and 10/13 (76.92%), respectively. The previous report relationship between rainfall and dengue prevalence by Wiwanitkit [6] is as the following 'the least square equation plot prevalence (y) versus rainfall (x) is Y = 3.0X + 4.6' [6] and the previous report relationship between rainfall and Ckikungunya infection prevalence by Wiwanitkitand Wiwanitkit [7] is as the following 'the derived least square equation plot prevalence (Y) versus rainfall (X) was Y = 0.8X+ 0.6' [7].

3.2. Modeling

Based on the derived relative immunoreactivity rate of Zika virus, the adjusted equation based on dengue and Ckikungunya virus infection situations can be 'Y = 2.29X + 3.52'(equation A) and 'Y = 0.64X + 0.48' (equation B), respectively; giving Y = prevalence of Zika virus infection (/100 000) and X = rainfall (inch). Further manipulation to summarization of equation A and equation B can yield the final equation 'Y = 1.47X + 2'./using this derived relationship, the geographic information system (GIS) map showing the relationship can be constructed as shown in Figure 1.

4. Discussion

As a mosquito borne infection, it is no doubt that climate factor becomes an important determinant for occurrence of Zika virus infection. The interrelationship between rainfall and occurrence of infection was firstly proposed by Althouse *et al.* [4]. Here, the authors use the mathematical technique to construct the new model for predicting the possible pattern of Zika virus prevalence in Thailand in case that there will be the future outbreak. The relationship between rainfall and other similar common arboviral disease is used as the template for the model. Based on the present study, the derived model shows that the rate of infection, in case of existed outbreak, will be similar high to the rate of dengue. This means the disease will becomes another major problematic arboviral disease in the country. In fact, the disease might already exist and spread in Thailand but it is under diagnosed because the infected cases can be asymptomatic or mild symptomatic [1,3]. Of interest, the data in his short communication is the first world report on the predicted interrelationship between Zika virus infection prevalence and rainfall. This data can be a useful tool for further disease surveillance in this area.

Conflict of interest statement

We declare that we have no conflict of interest.

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