The Effect of Temperature and Relative Humidity on Dengue fever in Mueang Nakhon Si Thammarat, Thailand.

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ABSTRACT

This study investigated the effect of temperature, relative humidity and temperature index on dengue fever and the number of mosquito larvae in Nakhon Si Thammarat, Thailand. Mosquito larvae data was collected during the COVID-19 epidemic, so samples were collected in the our home (8.3382430 N, 100.0468801 E) and our school (Princess Chulabhorn Science High School Nakhon Si Thammarat, 8.3684595 N, 100.0437717 E) by using the number of buildings instead of the number of houses. We identified *Aedes* larvae up to species level under microscope. The results showed that the mosquito larvae populations in Muang Nakhon Si Thammarat had house index of 62.5%. This indicated that Muang Nakhon Si Thammarat are dengue sensitive. Climate factors, Mean Temperature (°C), Relative Humidity (%) and temperature index affect to dengue cases in Muang Nakhon Si Thammarat in the times that no Coronavirus epidemic (2015-2019) years, $P > 0.05$. This area is the dengue high risk area according to the WHO standard for dengue risk area.

Keywords: Dengue Fever, *Aedes. aegypti* and Muang Nakorn Si Thammarat, Thailand

Research Question and Hypothesis :

Research Question : How do the temperature and relative humidity and the number of mosquito larvae influence the dengue cases in Muang Nakhon Si Thammarat?

Hypothesis : Temperature and climate affect vectorial capacity, extrinsic incubation period in mosquitoes, the disease will increase when the temperature warms up.

Introduction :

Dengue is transmitted to humans through the bite of certain species of female mosquitoes mainly of the species *Aedes. aegypti* that carry one of the virus's four serotypes: dengue viruses 1–4. (WHO 2018). These mosquitos mostly inhabit subtropical and tropical places. All four serotypes of the dengue virus are in active circulation, causing multiple outbreaks in Southeast Asia, This has caused health problems and causing the patient died each year, such as in Malaysia, Thailand, and Singapore, The actual numbers of dengue estimate indicates 390 million dengue infections per year (95% credible interval 284–528 million) (Bhatt S, Gething PW, Brady OJ, Messina JP, Farlow AW, Moyes CL et.al., 2017.), Thailand is a country affected by dengue fever. In 2015 shows the highest number of patients in 20 years, there were 142,925 cases and 141 deaths. (Bureau of sexually transmitted disease by insects, Department of Disease Control, the Ministry of Health, Thailand. 2017).

In 2019, 1474 dengue cases were reported in Muang Nakhon Si Thammarat, Thailand. Which the number of patients has steadily increased over the last four consecutive years. (Figure 1) (Province Health Office 2020). The previous report showed Dengue cases in Muang Nakhon Si Thammarat in the wet season were higher than in the dry season (Phuwadon Noradin, Thanayot Moungkaew and Thiranai Keatpimol, 2016 Virtual Science Fair) and Rainfall (mm) Rainy days (days) Mean Temperature and Relative Humidity (%) were positively correlated with dengue cases in Muang Nakhon Si Thammarat in El Niño times, and La Niña times, Rainy days (days) was only factor positively correlated with dengue cases, other factors were not significantly correlated with dengue cases. (Kasima Theangtum, Nichakan Chanprasit and Thanyachanok Paimanee, 2018 Virtual Science Fair). During the ongoing COVID-19 pandemic, countries worldwide have implemented physical distancing measures to reduce the spread of SARS-CoV-2, but the dengue outbreak is still high fever. Until entering the second consecutive year Of the COVID outbreak, That resulted in a slight decline in the outbreak. In the meantime, limitations of the study include the

possibility of underreporting cases due to fear of leaving one's home to seek medical treatment and the burden of the COVID-19 pandemic on healthcare systems.

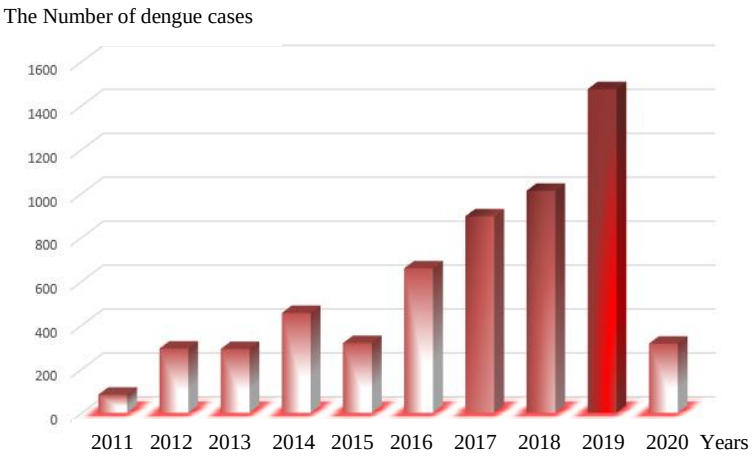

Figure 1. Monthly dengue cases at Muang Nakhon Si Thammarat, Thailand for January 2011- December 2020.

The objectives of this study are investigated the effect of temperature and relative humidity on dengue fever and the number of mosquito larvae.

Research Methods and Materials :

Study site : The study site was located at Muang Nakhon Si Thammarat, southern Thailand (8.415097 N and 99.965727 E) (Figure 2). This area is one of most dengue outbreaks in southern Thailand. This district is about 580.249 km^2 and 272,110 populations (Muang Nakhon Si Thammarat District Register Office 2020).

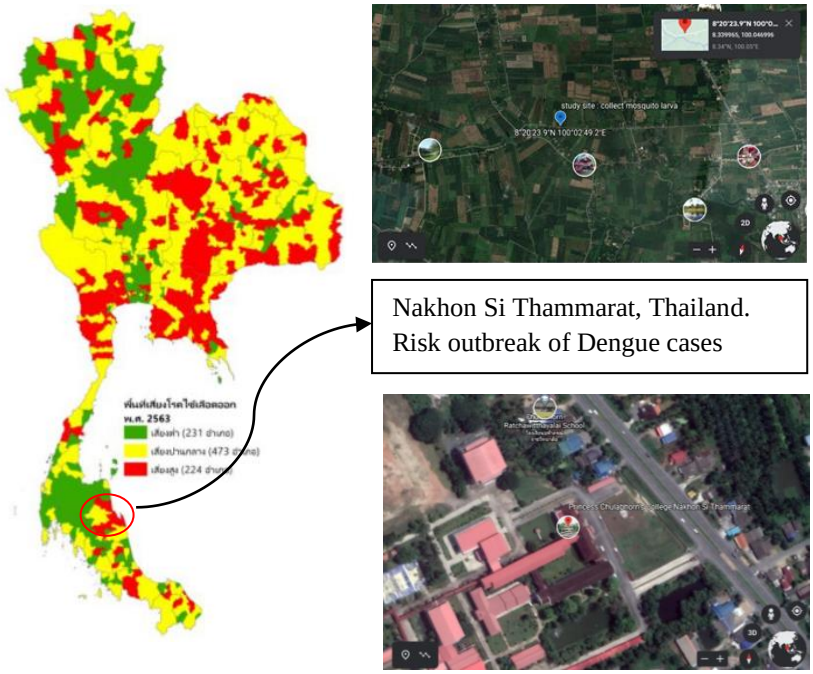

Figure 2. Map of Thailand and study site at Nakhon Si Thammarat province, Thailand

Data Collection

Dengue cases in January 2016-December 2020 were obtained from the Vector-Borne Disease Control Centre laboratory 11. Nakhon Si Thammarat atmospheric data were collected from Meteorological Department of Thailand during January 2016-December 2020.

Mosquito larvae data was collected during the COVID-19 epidemic, so samples were collected in the our home (8.3382430 N, 100.0468801 E) and our school (Princess Chulabhorn Science High School Nakhon Si Thammarat, 8.3684595 N, 100.0437717 E) by using the number of buildings instead of the number of houses.

Environmental studies

We collect daily weather information and mosquito larvae using GLOBE Observer.

Data analysis

House index was calculated as the number of positive households (building in study area) divided by the total number of households (total building) inspected. Household locations with the number of mosquito larvae were visualised, the research process during the COVID-19 epidemic, so samples were collected in the our home and our school by using the number of buildings instead of the number of houses. Descriptive statistics were calculated. Independent sampled t-test was used to test the mean differences of dengue cases and

climatic factors are influenced as relative humidity and daily temperature. The temperature index is the difference between the monthly mean temperature and the average of each month in the past 25 years. The study scope of correlation analysis is these correlations before the Coronavirus outbreak. Spearman correlations were used to test the association between dengue cases and climatic factors. The significant tests were two-tailed with significant level at $P<0.05$.

Results :

Number of Dengue cases, mean temperature and relative humidity.

Table 1 Spearman Correlation coefficient of dengue cases and climatic factors (N=60)

	Mean Temperature (°C)	**Relative Humidity (%)**	**Temperature index (°C)**
Spearman Correlation			
Dengue cases	-.290*	-.288*	-.320*
Sig.(2-tailed)	.024	.025	.013

Mean Temperature **(°C),** Relative Humidity (%) and temperature index were correlated with dengue cases in Muang Nakhon Si Thammarat in the times that no Coronavirus epidemic (2015-2019) years.

The number of dengue cases and temperature index.

The monthly trend line for the number of dengue cases and temperature index in 2015-2020 as showed in Figure 3.

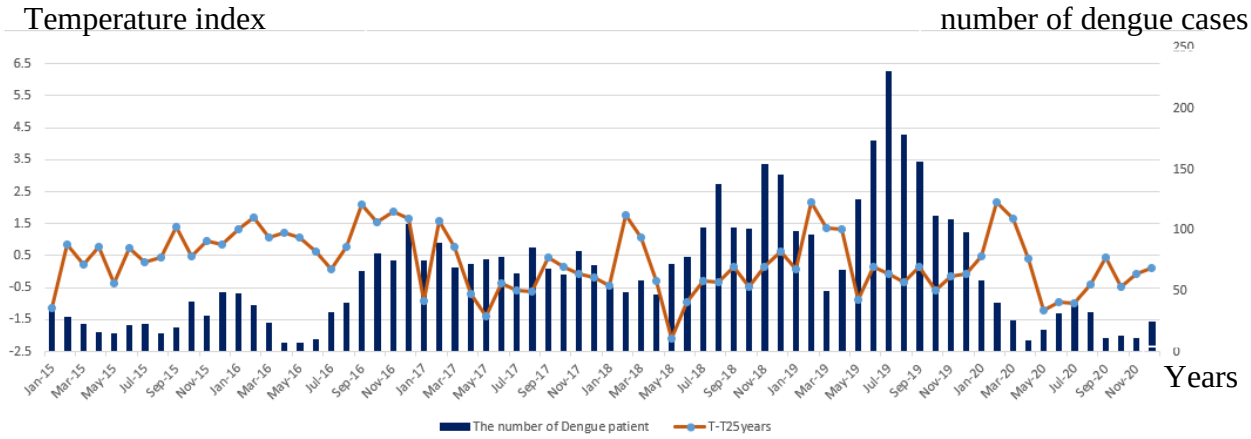

Figure 3. Monthly dengue cases and temperature index in 2015-2020.

It was found that the number of dengue cases and temperature index showed steady increase in the consecutive years before the epidemic, after that the number of dengue cases has decrease after COVID-19 outbreak in the last year.

House index at Muang Nakhon Si Thammarat

Table 2: Relationship between HI(%) in Muang Nakhon Si Thammarat.

	Aedes Larvae
No. of households (building)	16
No. of positive households (building)	10
House Index (%)	62.5

From the households collected in January 2021, house indices for *Ae*. aegypti and ***Ae.*** albopictus were very high(Table 2). Muang, Nakhon Si Thammarat have HI >5%, indicates that these districts are dengue sensitive.

Discussion

Climate change is affected influencing dengue cases such as Temperature variation influenced the vector efficiency of *Aedes*. Larvae. Beacure this effects on parasitism comprise, Temperature, humidity, affect the incidence of dengue, either through changes in the duration of mosquitoes and parasite life cycles or through their influences on human, vector, or parasite behaviour (Gubler et al. 2001, Wongkoon et al. 2013). Our results showed

that temperature and relative humidity were correlated with dengue cases before COVID-19 epidermic in Muang Nakhon Si Thammarat, Thailand. In figure 2, indicates that mosquito eggs tend to be more viable in high temperature than normal cold season, it mean that on when the temperature index higher than 25 years mean temperature the weather should be warmer than normal, identifying large effects of on dengue expected. The result are consistent with those demonstrating that the epidemic will increase when the temperature warms to 29 degrees celsius, but if it warms further then it is over the limit. There is an appropriate restriction of the epidemic. (Liu-Helmersson et al., 2014)

Larval surveillance during this study was important to find out the extent of prevalence of vectors in a locality. House index was used in this study to help stratifying DHF risk areas for further control and monitoring of the vector population in defined areas. House index from our study indicated a high risk of DHF transmission. The WHO standard for high DHF risk areas was 5 % house index. This indicates a high risk of DHF transmission in Nakhon Si Thammarat Province, Thailand. Our results showed 62.5 % house index for *Ae. aegypti* larvae at Muang Nakhon Si Thammarat. As we are GLOBE students, we should launch some campaign to raise some awareness on mosquito larvae in the area.

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