Impact of Climate Change on Dengue Haemorrhagic Fever in Central Java.

Onny Setiani

ABSTRACT
Background: *Dengue viruses, single stranded RNA viruses of the family flaviridae is increasing global concern in public health. They cause an estimated 50-100 million illnesses annually around the world This disease often show regular seasonal patterns in incidence because of the sensitivity of mosquito vectors to climate change. The objectives of this study are to study the vulnerability, assessment and adaptation measures of Dengue Haemorrhagic Fever (DHF) incidence in Central Java.*
Methods: *Twenty eight Districts in Central Java were selected for analysis of meteorological parameters and incidence of DHF from predictive value point of few. Annual time series analysis of data on temperature, humidity, rainfall, dengue fever incidence for a period of year 2000 until 2002 including the period of outbreak dengue were analyzed.*
Results*: The finding illustrate that DHF incidence has significant moderate positive correlation with air temperature and moderate negative correlation with total rain fall and relative humidity. The incidence of DHF in more likely consistent to temperature pattern than rain fall or humidity. Climate warming, expressed as a systematic temperature increase in most areas seems to be responsible for an increase of DHF incidence.*
Conclusions: *It is suggested that rain fall, humidity and temperature may be used for prediction of DHF incidence.*

Keywords: Climate change, Dengue Haemorrhagic Fever (DHF), Central Java

INTRODUCTION

Dengue fever is caused by infection with dengue viruses of the family *Flaviridae* and transmitted principally by *Aedes aegypti* mosquitoes in the tropical and subtropical regions of the world. Human and mosquitoes are the principal hosts of dengue virus in which the mosquitoes remains infected for life, but the viruses are known to cause illness only in human [1-5].There are four antigenically related that distinct the serotypes of dengue viruses, in which each serotypes cause strong homologous immunity but short -lived cross immunity to re-infection. Several hundred thousand cases of DHF are estimated to occur annually.

In Indonesia, epidemic of DHF has been well documented and was first recognized in 1968 on the Island of Java [6]. The geographic range of Dengue Haemorrhagic fever has expanded caused by the spread of its principal vector, *Aedes aegypty*. Over the last decades, dengue has shown dramatic increase in incidence within its range and many urban areas becoming endemic for the disease. In many areas

Dengue epidemics occur during the warm, humid, rainy seasons, which favor abundant mosquitoes and shorten incubation period. The disease is more prevalent and its prevalence is expected to increase. [7-11].

Weather and climate influence the mosquito vectors of dengue parasites. Meteorological conditions directly influence vector reproduction and mortality rates and thereby control population distribution and abundance. Epidemics of dengue fever and historical has been associated with the El Nino phase of the Southern Oscillation (ENSO). The southern Oscillation is a periodic inter-annual biphasic variation in sea level pressure across the Pacific ocean that drives a complex global system of meteorological perturbations.

The El Nino period is characterized by high surface pressure over the Western Pacific and low surface pressure over the southeastern pacific, termed La Nina. Due to the significant role of El Nino plays in global climatic variability there have been many attempts to establish weather global warming will result greater occurrence and or intensity of El Nino events. Several climate model have shown that ENSO like events will continue into the future. ENSO affects many of climatic elements that are linked to the health such as temperature in the case of heat stress and precipitation and wet conditions. Many El Nino sensitive areas are also affected by epidemics of dengue fever during La Nina years which are associated with anomalously high temperature and rainfall in this area [12-15]

Onny Setiani, MD,Ph.D Magister program of Environmental Health Diponegoro University

METHODS

This research was an observational retrospective study on the correlation of several climate parameters on incidence of dengue hemorrhagic fever (DHF) in Central Java Province, Indonesia.

Twenty eight districts and cities in Central Java province were selected for analysis of meteorological parameters and incidence of DHF from predictive value point of few. The selected districts were Cilacap, Banyumas, Purbalingga, Banjarnegara, Kebumen, Purworejo, Wonosobo, Magelang, Sukoharjo, Wonogiri, Karanganyar, Grobogan, Pati, Kudus, Jepara, Semarang, Temanggung, Batang, Pekalongan, Pemalang, Tegal, Brebes, Magelang City, Surakarta City, Salatiga City, Semarang City, Pekalongan City and Tegal City.

Annual time series analysis was conducted on data of temperature, humidity, rainfall and DHF cases in the period of 3 years from 2000 until 2002, that include the period of DHF outbreak. DHF cases during research period were collected from local district health office and the data were cross-checked by data from Central Java Central.

Statistics Agency at the same year. Climate data were collected from the Department of Meteorology and Geophysics of Central Java Province. Climate data were the average of annual temperature (ºC), humidity (%) and totals rainfall (mm). Since the data were not normally. distributed, the correlation between DHF incidence and temperature, humidity or rain fall were analyzed using Spearman-rank correlation.

The value of $p \leq 0.05$ was considered as significant.

RESULTS AND DISCUSSION

Central Java province is located along the equator between 5º40' to 8º30' East longitude (include Karimun Jawa Archipelago). The longest distance from West to east is 263 km and from North South is 226 km (Karimun Jawa archipelago is not included). The largest land of area is Cilacap district (213, 851 ha) and the smallest is Magelang city (1812 ha). District with the largest population is Brebes district (1,728,808 people) and the smallest is Magelang city (116,498 people). Surakarta city has the highest population density (11087.17 people/km^2) and the lowest is Wonogiri district (534.66 people/km^2).

According to meteorological data (average of 3 years), Magelang city had lowest average temperature (18.3ºC) and Surakarta city was the highest (28.6ºC). The highest humidity was recorded in Temanggung district (92.3 %) and lowest was in Banyumas district (76.0%). The highest rain fall was in Wonosobo district (4341.3 mm) and the lowest was in Pati district (1180.0 mm).

The correlations between DHF incidence and climate parameter were showed in table 1.

Table 1. Correlation coefficient between annual DHF incidence, air temperature (ºC), rain fall (mm) and relative humidity (%) in 28 districts / cities of Central Java province in the period of year 2000 until 2002. Value in the bracket is the level of significant

Parameters	DHF incidence	Air temperature	Rain fall	Humidity
DHF incidence	1	+0.5 (p<0,001)	-0.4 (p<0,001)	-0.5 (p<0,001)
Air temperature		1	-0.3 (p=0.023)	-0.6 (p<0.001)
Rain fall			1	+0.3 (p=0.005)
Humidity				1

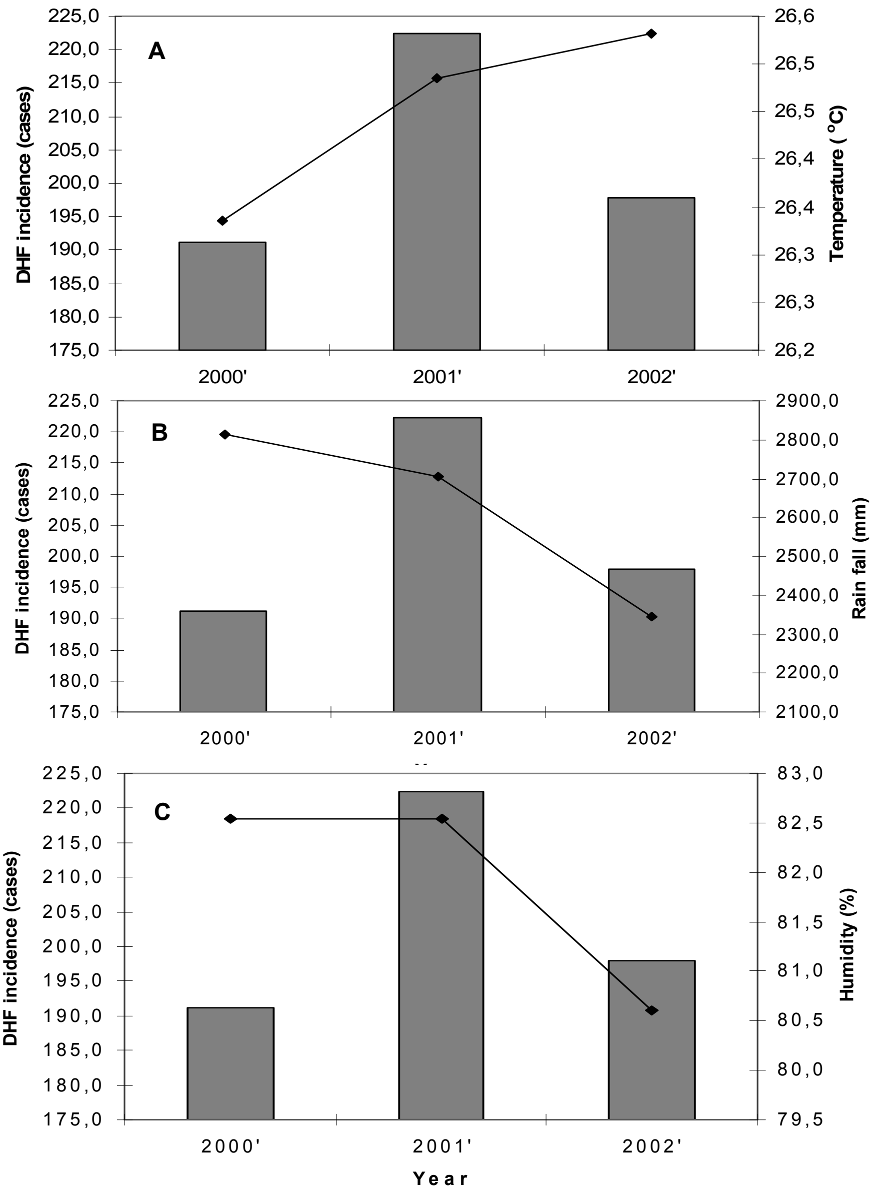

Figure 1. The change of DHF incidence from year 2000 to 2002 according to the change of climate parameters i.e. average of temperature (A), total rain fall (B) and relative humidity (C).

According to data in table 1, DHF incidence has significant moderate positive correlation with air temperature and moderate negative correlation with total rain fall and relative humidity. It's means DHF incidence was linearly increase according to the increase of temperature and decreased when rain fall was high and when weather was more humid.

The time series of DHF incidence and the climate parameters were showed in figure 1.

The value of DHF incidence, temperature, total rain fall and humidity were average of data from 28 districts/cities in Central Java Province on the period year 2000 to 2002.

The diagrams show that the incidence of DHF was lowest in year 2000. The highest incidence of DHF was occurred on year 2001, and decreased on year 2002.

The diagram also show the temperature also sharply increase from year 2000 to year 2001. From 2001 to 2002 the temperature was also increased, however, was not sharp as previous. The rain fall tend to be decrease from year 2000 until 2002. It was clearly showed that the change of temperature is negatively related to the change of total rain fall.

The humidity was not so different at the year 2000 and 2001, and decrease on year 2002. The decrease of humidity may due to reduction of total rain fall.

The average of DHF incidence on each districts/cities of Central Java Province from year 2000 to year 2002 plotted against temperature, rain fall and relative humidity were shown in figure 2.

The code of area: 1=Cilacap District, 2= Banyumas District, 3=Purbalingga District, 4=Banjarnegara District, 5=Kebumen District, 6=Purworejo District, 7=Wonosobo District, 8= Magelang District, 9=Sukoharjo District, 10=Wonogiri District, 11=Karanganyar District, 12=Grobogan District, 13=Pati District,14=Kudus District, 15=Jepara District, 16=Semarang District, 17= Temanggung District, 18=Batang District, 19= Pekalongan District, 20= Pemalang District, 21= Tegal District, 22=Brebes District, 23= Magelang City, 24= Surakarta City, 25= Salatiga City, 26=Semarang City, 27= Pekalongan City, 28=Tegal City

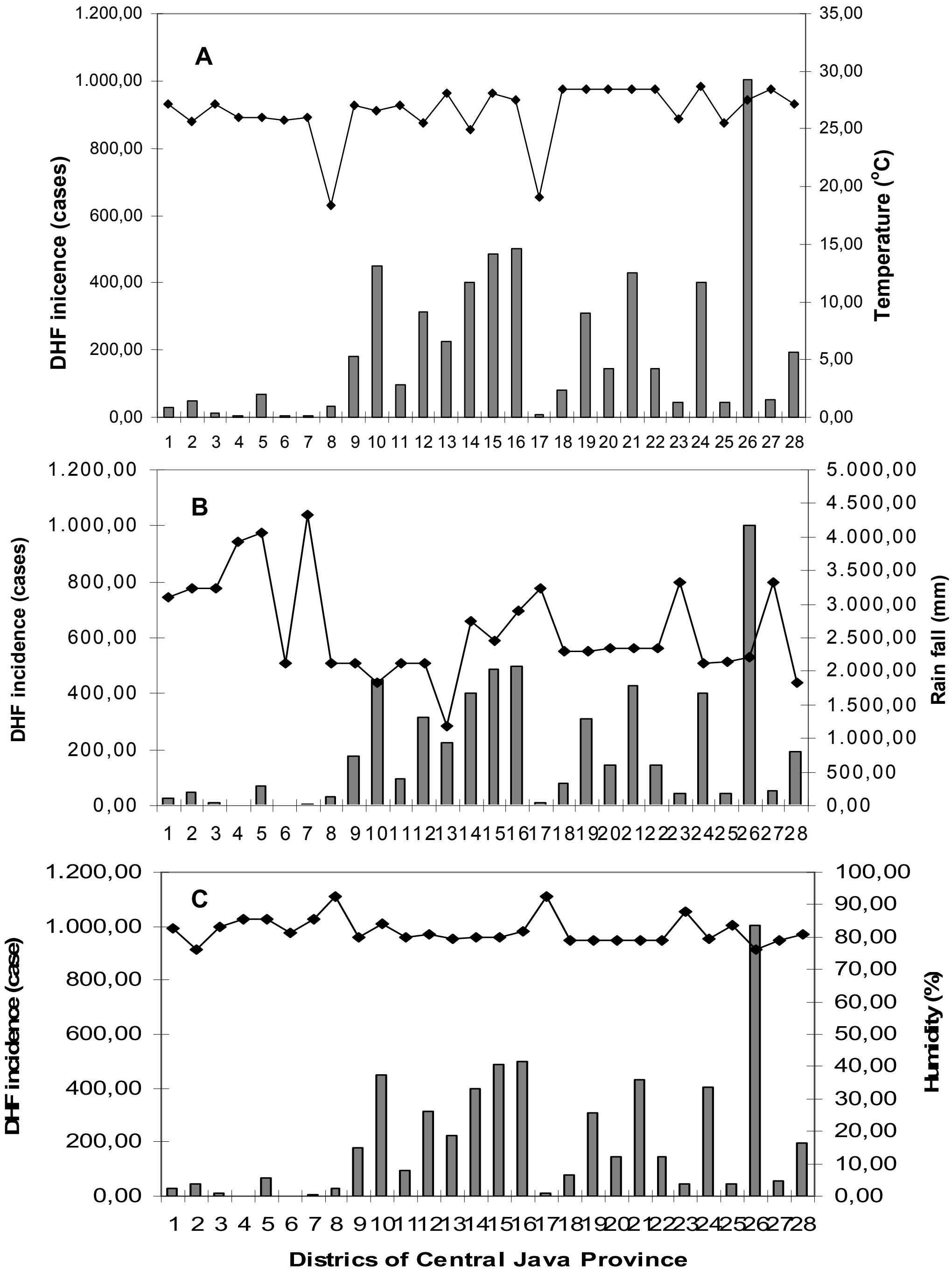

Figure 2. The average of DHF incidence on each districts / cities of Central Java Province from year 2000 to year 2002 plotted against temperature (A), rain fall (B) and relative

According to figure 2, the incidence of DHF in more likely consistent to temperature pattern than rain fall or humidity. The variability occurred with temperature, whereas the incidence of DHF increased at high temperature and low rainfall. The results suggest that DHF transmission suitability has increased because of climate change in most locations in Central Java. The minority of areas with variable transmission potential showed no evidence of trends in climate suitability. Climate warming, expressed as a systematic temperature increase in most areas seems to be responsible for an increase of DHF incidence. Areas where found that climate was becoming more suitable for transmission had experienced decreased rain fall with high temperature. Areas of highly variable and climate suitability were also driven by fluctuations of temperature, rainfall and humidity.

CONCLUSION

DHF incidence has significant moderate positive correlation with air temperature and moderate negative correlation with total rain fall and relative humidity. Areas where found that climate was becoming more suitable for transmission had experienced decreased rain fall with high temperature. The incidence of DHF is more likely consistent to temperature pattern than rain fall or humidity. Areas of highly variable and climate suitability were also driven by fluctuations of temperature, rainfall and humidity. It is suggested that rainfall, humidity and temperature may be used for prediction of DHF incidence.

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