Tropical Climatic Variability and Dengue Hemorrhagic Fever Incidence in the city of Padang, West Sumatra, Indonesia: An Ecological Study of 10 -Years Data (2003 - 2012)

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Background

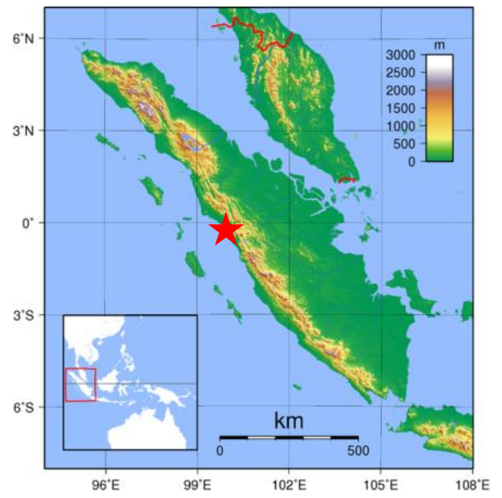
- Dengue transmission has a strong seasonal pattern, which is believed to be increased from year to year mosquito density.
- Climatic factors are important determinants of dengue seasonality.
- In tropical regions, a distinct seasonal pattern in DHF outbreaks is evident in most places where monsoon weather patterns predominate.
- Therefore, the research were needed for assessing the risk.

Objective

To assess the use of a cyclical pattern statistical model for DHF incidence based on climatic factors, incorporating seasonal/cyclical trends for the city of Padang, Indonesia.

Study Site

The city of Padang is located in the equator line on the west coast of Sumatra, Indonesia with the tropical climatic zone, a natural habitat for *Aedes* mosquitoes, and the principal vector of dengue viruses.



Source :
Wikipedia,
http://en.wikipedia.org/wiki/Sumatra

Methods

- Retrospective data analysis
  –Data from January 2003-Desember 2012 (120 months)
- DHF Incidence data was obtained from Padang District Health Office, Indonesia
  –The monthly DHF Incidence in Padang City
- Climatic data was obtained from Bureau of Meteorology, Climatology and Geophysics in Padang City, Indonesia
  –The monthly total rainfall, rainydays, monthly average temperature.
- A time series analysis model was applied to demonstrate the effect of climatic factor on DHF incidence, the equation is:
  –DHF incidence = constant + trend + cyclic/seasonal effect + climatic factors + noise

$$\ln(Y_t)=\beta_0 + \beta_1 t + +\beta_2 \cos(2\pi f t_1) + \beta_3 \sin(2\pi f t_1) + \beta_4 \cos(2\pi f t_2) + \beta_5 \sin(2\pi f t_2) + \beta_6 \cos(2\pi f t_3) + \beta_7 \sin(2\pi f t_3) + + \beta_8 Temperature + \beta_9\ Rainfall + \beta_{10}\ Rainydays + \omega(t)$$

- Data analyses were performed using R software version 3.1.1 (The R Foundation for Statistical Computing)

Discussion

- The studies the effect of climatic variability and cyclical pattern on dengue with time series analysis has been used extensively.
- Despite the climatic factor did not much explain the variation of DHF incidence, but an elevated temperature and rainfall have a positive associated with increasing incidence of DHF.
- This finding is in similar results with other studies in Thailand, South Korea and Brazil , but with a different cyclical pattern.

Conclusions

- The monthly DHF incidence patterns were predicted to rise with climatic factors and seasonal effect.
- The cyclical/seasonal effect can explains the majority of the variation in DHF incidence.
- Periodically, assessing exposure to climatic factors is complex. Therefore, assessing climate change vulnerability is important in the future.

Acknowledgements

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Results

Figure 1. Periodicity and trend analysis of DHF cases and climate variabilities in the city of Padang, Indonesia, the period January 2003 – December 2012 (120 months)

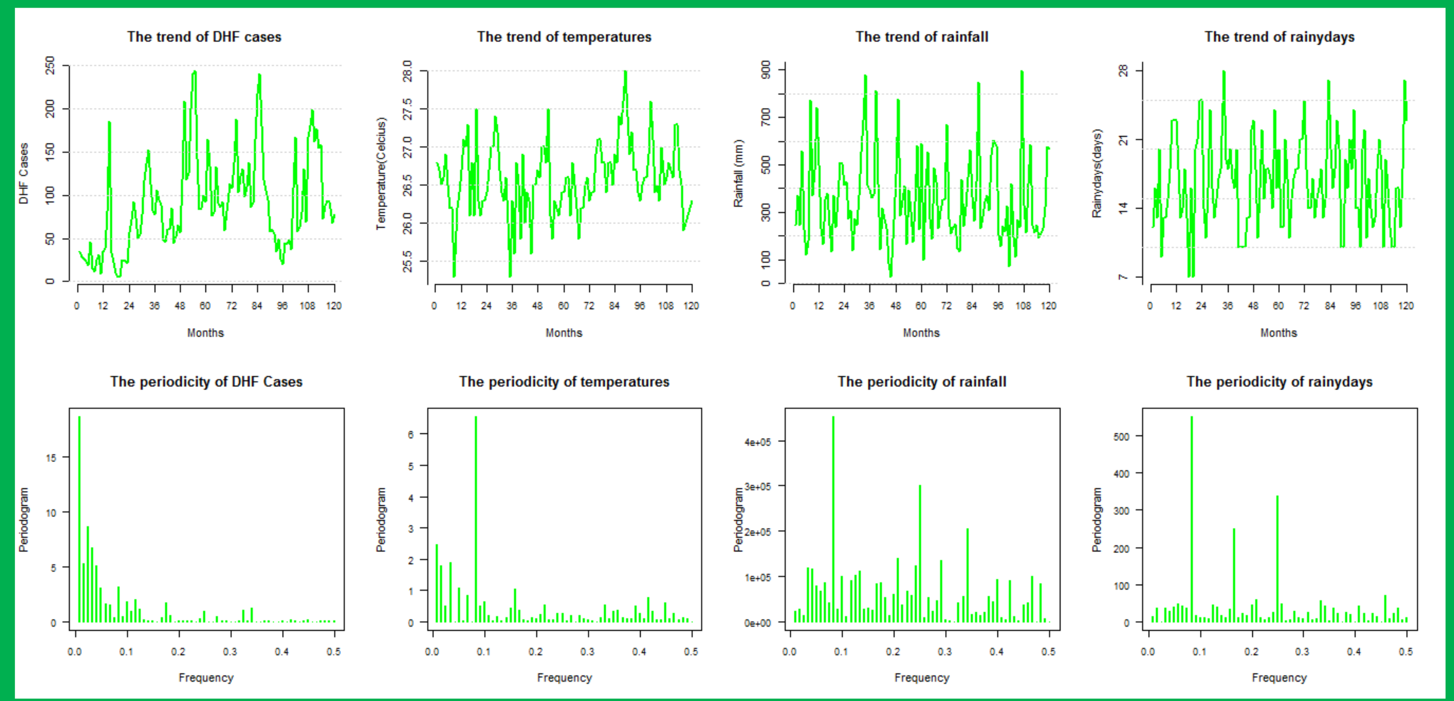

Figure 2. The model with only linear (t) + quadratic (t^2) trend (Model 1) and linear (t) + quadratic (t^2) trend + cyclical patterns (Model 2)

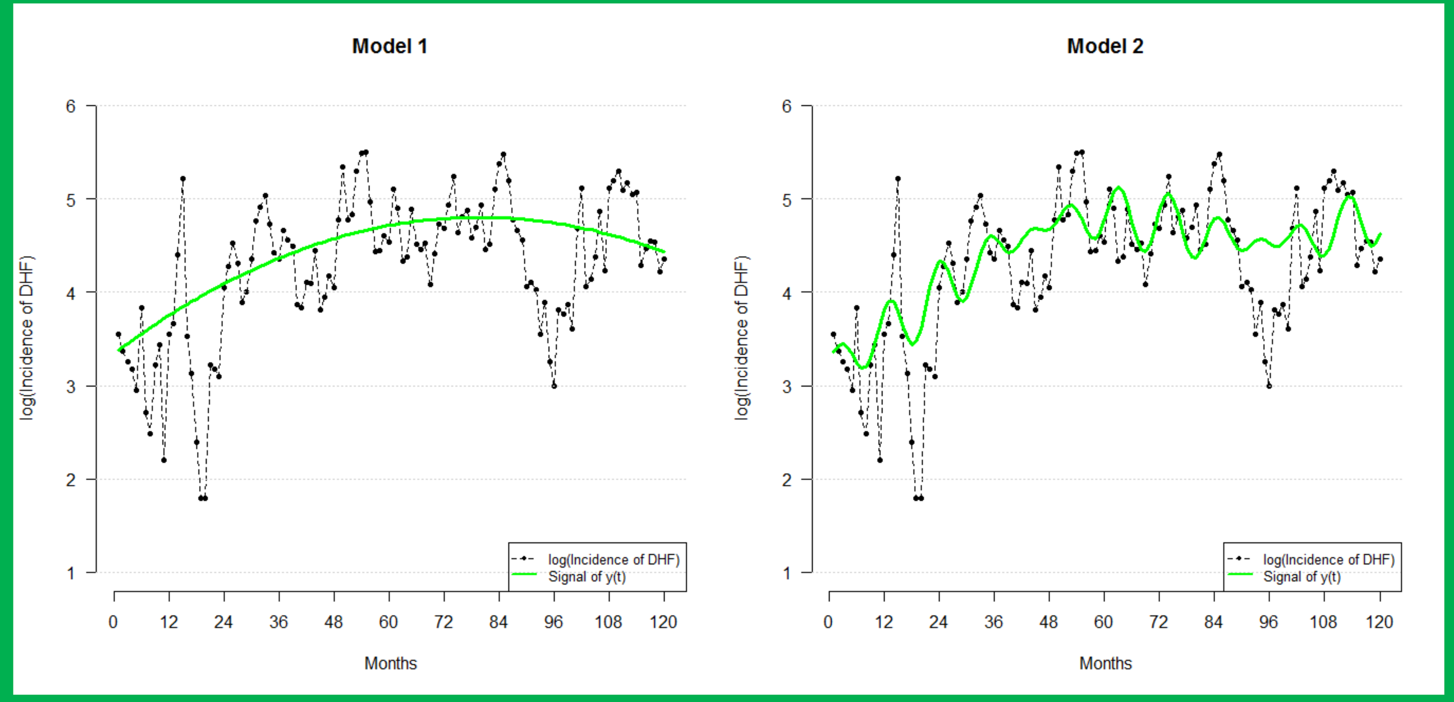

Table 1. Poisson regression model of DHF monthly cases on trends, quadratic trend, cyclical patterns and climatic factors

	Model I			Model II			Model III		
	β	S.E.	Pr(>|z|)	β	S.E.	Pr(>|z|)	β	S.E.	Pr(>|z|)
(Intercept)	3.3429	0.0405	0.0000*	3.5845	0.0788	0.0000*	-6.2503	0.7250	0.0000*
t	0.0366	0.0013	0.0000*	0.0200	0.0031	0.0000*	0.0115	0.0004	0.0000*
t^2	-0.0002	0.0000	0.0000*	-0.0001	0.0000	0.0038*			
sin(2 * pi * 0.01 * t)				-0.0111	0.0263	0.6721	-0.0327	0.0151	0.0306*
cos(2 * pi * 0.01 * t)				-0.3403	0.0251	0.0000*	-0.4881	0.0175	0.0000*
sin(2 * pi * 0.08 * t)				-0.0343	0.0139	0.0133*	-0.0972	0.0152	0.0000*
cos(2 * pi * 0.08 * t)				0.1591	0.0137	0.0000*	0.0650	0.0151	0.0000*
sin(2 * pi * 0.1* t)				0.1328	0.0138	0.0000*	0.1203	0.0138	0.0000*
cos(2 * pi * 0.1 * t)				-0.1274	0.0137	0.0000*	-0.1866	0.0144	0.0000*
temperature							0.3785	0.0269	0.0000*
rainfall							0.0003	0.0001	0.0002*
rainydays							-0.0079	0.0029	0.0057*
AIC	3682			3150.6			2945.9		

Akaike Information Criterion (AIC), *p-value < 0.05

Figure 3. The model with trends + cyclical patterns +climatic factors (Model 3)

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