INVITATION LETTER

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September 14, 2013

Dear Hamzah Hasyim,

The 45th APACPH (Asia Pacific Academic Consortium for Public Health) Conference will be hosted by the School of Public Health at Wuhan University in Wuhan, P. R. China from the 25th to the 27th of October, 2013. The APACPH Conference is the most influential public health conference in the Asia-Pacific region. The theme of this year's conference is "Global Health" which reflects the need for innovative mechanisms to address the most pressing problems throughout the Asia and Pacific Regions today.

On behalf of the Organizing Committee of the conference, we are happy to invite you to attend the 45th APACPH Conference. For further information, please send an email to apacph2013@whu.edu.cn directly.

We look forward to your presence at the 45th APACPH Conference!

Yours sincerely,

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Linkages Between Climate Variability And Dengue Hemorrhagic Fever in Palembang, Indonesia

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To be presented for The 45th APACPH (Asia-Pasific Academic Consortium for Public Health) at School of Public Health, Wuhan University, China, 25[th] – 27[th] October 2013

Abstract

Background: The impact of global warming is already evident in Indonesia. Numerous studies already documented the linkages between climate variability and infectious diseases and have highlighted the correlation between climate and dengue transmission.Mosquito borne arboviruses are more important in a public health, cause of morbidity and mortality that it will be influenced by availability among of habitat and environmental conditions and also climatic change because most of populations have different vulnerabilities to climate and susceptibility to disease that may affect human health both directly and indirectly, although the extent of the effects is unclear.According from Ministry of Health Republic Indonesia regulation no.1501 in 2010. DHF is one of diseases that has outbreak potential in Indonesia and Dengue Fever cases, one of a global commitment to the MDGs.
Methods: From this research through secondary and literature review analysis, to describe trend and to identify linear correlation amongst climate variability like rainfall and rainy days and incidence of DHF. Data had been collected from some sources like trend of epidemiology of DHF from Ministry of Health of Republic Indonesia, climate variability data from Indonesian agency for meteorology climatology and geophysics and supporting data from journal review.
Results : From the research results obtained there is a correlation analysis between rainfall and DHF (pv = 0,001 and r = 0,358) and not significant relationship between rainy days and DHF (pv = 0,079 and r = 0,174) but both of them showed a positive pattern.
Discuss : From this result by means of correlation analysis we explored the possible impact of climatological variability events like rainfall and rainy days on the occurrence of DHF, that needed adaptation and mitigation action to anticipate incline the DHF incidence after increasing rainfall and rainy days.
Conclusions: The result of research that will need policy to implement EWARS in Health Department, to prepare adaptation and mitigation specially for vulnerable populations, giving the IHR to the decision maker, to improve community awareness about PHEIC.

Keywords: Climate variability, DHF, EWARS

Introduction

Our climate has been constantly changing since the Earth began with periods of global warming and global cooling. The record shows that there is an increase in global average surface temperature by about 0.7°C. Although this increase is small, it has big impact on our climate. Climate variability has wide-ranging effects on the environment, human health, socio-economic and related sectors. Rising temperature associated with climate change could change the distribution of diseases, such as dengue fever. The impact of global warming is already evident in Indonesia, including South Sumatra region. Numerous studies already documented the linkages between climate change and infectious diseases and have highlighted the correlation between climate and dengue transmission. (Krämer et al., 2011, Black et al., 1984, Khan et al., 2011). Many research wrote climate plays an important role in the transmission of many infectious diseases; it not only determines spatial and seasonal distributions, but also influences inter-annual variability (Kelly-Hope and Thomson, 2008, Haines et al., 2006, Hales et al., 2002, Thomson et al., 2008, Lafferty, 2009, Haryanto, 2009). According from Ministry of Health Republic Indonesia regulation no.1501 in 2010, DHF is one of diseases that has outbreak potential in Indonesia and DF cases, one of a global commitment to the Millennium Development Goals (MDGs). (WHO, 2013a). Furthermore, the impacts of climatic change on human health are complex, specially in vulnerable populations because they have different vulnerabilities to climate and susceptibility to diseases included DHF (Thomson et al., 2008, Costello et al., 2009, Jankowska et al., 2012, Hitz and Smith, 2004, Russell, 1998, Haines et al., 2006). Numerous studies already documented mosquito borne arboviruses are more important in a public health. (Russell, 1998, Thomson et al., 2008, Woodward et al., 1998, Lafferty, 2009, Shuman, 2010, Pounds et al., 1999). Existing theoretical models of the potential effects of climate change on vector-borne diseases not only account for social factors namely population increase but also interactions between climate variables.(Krämer et al., 2010, Hales et al., 2002). Many research found correlation between climatological variability events for example monthly data for temperature, rainfall, rainfall anomalies, humidity on the occurrence of DHF, for instance research on eight provinces found significant Pearson correlations were observed between dengue/DHF incidence and at least one climate variable ($r = \pm 0.2$ to ± 0.43; $P < 0.05$). (Arcari et al., 2007). According from data above, that it is important to make correlation among climate variability data for instance rainfall, rainy days data (average inches) and the prevalence of dengue infection. The relationship between climate, human behavior and infectious disease is complex, making it difficult to disentangle the different causal mechanisms. Although, there is relatively sparse evidence of these climatic influences at inter annual scales (Cazelles et al., 2005). Implications of the study is significance information for decision maker about health impacts of climate change and then the correlation between the data was assessed by regression analysis.

The WHO estimates that **neglected tropical diseases** (NTDs), affect over one billion people each year and cause about 570,000 deaths annually, one of NTDs is DF/DHF. Moreover, prevention and control of NTDs will contribute directly to the attainment of several MDGs (Pinheiro et al., 2011, Krämer et al., 2010). Currently it is endemic in more than 100 countries and is spreading. (King et al., 2000). Furthermore DF/DHF is a growing public health problem in the subtropics, in many parts of the world and in the absence of a vaccine. It has emerged as an important public health problem in Indonesia due to the high morbidity and mortality in children. (Woodward et al., 1998, Kusriastuti et al., 2004, WHO, 2013b, Earnest et al., 2012). Dengue was first reported in Indonesia in 1968 and when 58 clinical DHF cases and 24 deaths were reported from Surabaya and Jakarta. Since then, the disease has continuously spread to different areas of the country, mainly in cities and towns.(Suroso et al., 1993, E Setiati et al., 2006). According from the Ministry of Health Indonesia, DHF is ranked as number 8 among the ten most important infectious diseases in the country in terms of funding and political commitment. Since 1970, the worldwide distribution, frequency and intensity of epidemics of dengue and dengue haemorrhagic fever (DHF) have increased dramatically. In Indonesia, as elsewhere, the geographic distribution and behaviour of the two main vectors – Aedes aegypti and Aedes albopictus– and the consequent transmission dynamics of the disease are strongly influenced by climate. Increasing dengue incidence has been attributed to climate change; although contradicting reports show inconclusive relationships between dengue and climatic factors.

Currently, more than 300 districts are reporting cases and more than 200 million people living in urban and rural areas are at risk. (Kusriastuti and Sutomo, 2005). In another research about DHF, found Incidence Rate (IR) of DHF in Indonesia in 2008 amounted to 59.94 per 100,000 population, (national target = 20 per 100,000 population). DHF trend patterns from year 1968 to 2008 showed that case rates increased sharply. Moreover in other research showed, an outbreak of DF / DHF and dengue shock syndrome (DSS) in the city of Palembang, South Sumatra, Indonesia was investigated. (Corwin et al., 2001, Bangs et al., 2006, Hamzah Hasyim, 2008, Djati, 2011). From some researchers found there are evidence on the multiple pathways linking environmental variables and the following demographic variables and mathematical models (de Sherbinin et al., 2008, Roberts and Heesterbeek, 2004, Arcari et al., 2007, Gharbi et al., 2011). Advances in GIS technology, developed by geographers, provide new opportunities for environmental epidemiologists to study associations between environmental exposures and the spatial distribution of disease. (Krämer and Roth, 2002, Vine et al., 1997). To illustrate, link up and evaluate the cases could be collected by spatial data GIS ArcView 3.2 and ESRI. (Türk et al., 2004, Hostert and Gruebner, 2010). From the describes above that the purposes of this paper, to describe correlation between climate variability and dengue hemorrhagic fever in Palembang.

Materials and Methods

Research Method(s)

Ecological study design used by this research and then followed by explore of journal to find relevant research. An ecologic study focuses on the comparison of groups, rather than individuals (Morgenstern, 1995, Morgenstern, 1982) but ecological fallacy in this research may became. (Diez, 2002). Although the design have weakness, the ecologic analysis very important use in epidemiologic research and health planning, that has been given by health scientists and practitioners to the methodological aspects of this approach. (Morgenstern, 1982)

Methods

Dengue prevalence data, in Palembang, Indonesia were derived from the reported registry data on dengue from health communities in health municipal in Palembang. Climate variability data for instance rainfall, rainy days data (average inches) in the studied area were derived from Indonesian agency for meteorology climatology and geophysics Palembang. The correlation between the rainfall, rainy days data and the prevalence of dengue was assessed by regression analysis. The geographical data were transformed into the rainfall according to the rainfall distribution as previously mentioned and presented as millimeters. The overall infection rate of dengue were transformed into the prevalence and presented as percentage. The correlation between the rainfall and the prevalence of dengue was assessed by regression analysis. The least square equation plot prevalence (Y) versus rainfall (X_1), rainy days (X_2) and the correlation coefficient (r) was calculated.

Results and Discussion

From the research results obtained there correlation analysis climate variability and DHF shows the table below,

Table 1. Regression analysis between rainfall, rainy days and DHF

Variabel	r	R	Liner regression	pv	SSE
DHF	0,358	0,128	DBD = 1,555 + 0,017* rainfall	0,000	5,578
DHF	0,174	0,030	DBD = 3,153 + 0,183* rainy days	0,079	5,88

For some researches found the same result like in Pekan Baru and Jakarta, Indonesia, there is significant correlation between rainfall and DHF, but different result found from another research (Andriani, 2001, Erdinal, 2000). In addition, a predictive model equation plots dengue incidence (Y) versus rainfall (X), which suggests that rainfall is significantly correlated to dengue incidence ($r2 = 0.377$, $p < 0.05$). Evidence shows dengue incidence in Metro Manila varies with changing rainfall patterns.(Sia Su, 2008). The study indicated that the prevalence of dengue infection in Thailand depend on rainfall. However, the other confounding factors like ambient temperature and humidity which also determine the transmission of dengue should be looked into, before concluding that the increased prevalence is a result of rainfall alone. Further, similar studies to assess the correlation between the rainfall and prevalence of infection in the other countries are required to confirm these observations (Wiwanitkit, 2006). Increases in weekly minimum temperature and rainfall were also significant factors in the increase in the reported cases of dengue. The author recommend future studies using the same method, involving larger populations with different geographic location, climate and weather and strengthening environmental, health and entomological surveillance systems to improve preparedness and emergency responses.(Hurtado Díaz et al., 2007) However, an epidemiological study on the distribution of incident cases of DHF with the Geographical Information System approach shows that in addition to the factors that cause the occurrence of DHF (population density, temperature, rainfall, humidity) as well as the clustering of DHF cases in specific locations (spatial) and occurs at a specific time (temporal) (Astutik et al., 2011). This prospective study highlighted rain, temperature and relative humidity as the major and important climatic factors, which could alone or collectively be responsible for an outbreak. More studies in this regard could further reveal the correlation between the climatic changes and dengue outbreaks, which would help in making the strategies and plans to forecast any outbreak in future well in advance. (Chakravarti and Kumaria, 2005). Establishing links between climate and disease is a good idea and this study has information of value. Recently, Goncalves Neto and Rebelo (2004) reported a positive correlation with the amount of rainfall and relative humidity. Similar results were also reported by other studied groups in the recent years (Guzman and Kouri 2003; Chakravarti and Kumaria 2005).

The correlation between rainfall and infection rate of dengue is of interest. The outbreak coincided mainly with the post monsoon period of subnormal rainfall, which was followed, by relatively heavy rainfall during the monsoon period; from June to September (Chakravarti and Kumaria, 2005)

In addition from one of research, that the results imply that temperature-induced variations in the vector efficiency of Ae.aegypti may be a significant determinant in the annual cyclic pattern of dengue hemorrhagic fever epidemics in Bangkok.(Watts et al., 1986). The authors found that median temperature during the rainy season was the strongest predictor of dengue infection, with an adjusted fourfold risk in the comparison of 30°C with 17°C. High temperatures increase vector efficiency by reducing the period of viral replication in mosquitoes. (Koopman et al., 1991). No significant correlations were observed between temperature and DF or DHF incidence but rainfall was found to be significantly correlated with DF incidence, with a clearly defined 'dengue season', between June and November, in two of the study years (Chadee et al., 2007). This will be possible only when knowledge about the relationship of DF/DHF with climatic and physio-environmental agents is discovered. (Nakhapakorn and Tripathi, 2005). Likewise, there are correlation temperature and rainfall, affecting dengue incidence in Metro Manila from 1996 to 2005, for were collected over a 10-y period. Climatic factors temperature and rainfall were linked with dengue incidence through regression analysis. (Sia Su, 2008). Furthermore, have been done a statistical model for predicting monthly Dengue Hemorrhagic Fever (DHF) the model uses past and present DHF cases, climate and meteorological observations as inputs. These inputs are selected using a stepwise regression method to predict future DHF cases from the city of Makassar. The most important input variable in the prediction is the present number of DHF cases followed by the relative humidity three to four months previously. A prediction 1–6 months in advance is sufficient to initiate various activities to combat DHF epidemic. The model is suitable for warning and easily becomes an operational tool due to its simplicity in data requirement and computational effort. (Halide and Ridd, 2008). Moreover, a retrospective study to determine relationships between the incidence of dengue cases and climatological variables. The study used the weekly dengue cases and precipitation data for around 5 years. The study the strongest correlation with the vapour pressure at a lag of 6 weeks. A weaker correlation occurred at a lag of 7 weeks for the precipitation. The minimum temperature had its strongest correlation at a lag of 12 weeks and the maximum temperature a lag of 16 weeks. There was a negative correlation with the wind speed at a lag of 3 weeks. The predictive models showed a maximum explained variance of 35%. (Depradine and Lovell, 2004). And then in study was to determine the independent effects of climatic factors: rainfall, temperature and relative humidity, on the occurrence of DHF in Thailand after adjustment for cyclical pattern. Data regarding monthly DHF reported cases by province, monthly rainfall, rain-days, average daily maximum temperature, average daily minimum temperature and average relative humidity and mid-year province population from around 240 months that it found that the general equation: Incidence of DHF = constant + trends + cyclic effects + climatic factors + noise was used as the statistical model, whereas increased rainfall was associated with a decreased incidence of DHF in 7 provinces. Analysis by region shows that DHF incidence was negatively associated with extra rainfall in the southern region, but was positively associated with elevated temperatures in the central and northern regions. Variability in incidence was explained mostly (14.7% to 75.3%) by trend and cyclic change and much less (0.2% to 3.6%) by independent climatic factors.(Thammapalo et al., 2005).

Rainfall appears to be the principal climatic agent affecting the geographic distribution and temporal pattern of incidence while temperature appears to play a critical role in outbreak intensity. Wide regional and temporal variations in the strength and nature of the observed associations led to the identification of three groups of provinces where increases in dengue/DHF incidence were variously associated with increased rainfall, decreased rainfall and/or high susceptibility to climate variability. (Arcari et al., 2007) Evidence shows dengue incidence in Metro Manila varies with changing rainfall patterns. (Sia Su, 2008). In addition, research that assessed the impacts of rainfall, temperature and human activities on the temporal dynamics of adult Ae. aegypti and oviposition was significantly correlated with dengue incidence.(Barrera et al., 2011). Besides this, the abundance and the transmission potential of Ae.aegypti are influenced by temperature and precipitation. The result shown a positive and statistically significant association between monthly changes in temperature and precipitation and monthly changes in dengue transmission in Puerto Rico and also found that the strength of this association varies spatially, that this variation is associated with differences in local climate and that this relationship is consistent with laboratory studies of the impacts of these factors on vector survival and viral replication..(Johansson et al., 2009). A retrospective ecological study found that the increases in weekly minimum temperature and rainfall were also significant factors in the increase in the reported cases of dengue. (Hurtado-Díaz et al., 2007)

Space-time clusters showed that dengue transmission is a contagious type as the spacetime extent is limited at 200m and 20 days and mainly involved household transmission..(Seng et al., 2005) And then, in one of research that found that the population of Ae. aegypti was driven by weather and human activities and peaks in mosquito density preceded maximum dengue incidence during the rainy season. (Barrera et al., 2011). Climate directly influences the biology of the vectors and thereby their abundance and their distribution. Significant correlations have been reported between annual dengue incidence and estimates of Aedes aegypti populations at a national scale, using climate-based models. (Cazelles et al., 2005). Nevertheless, the interplay between infected travelers, climate, vectors and indigenous dengue incidence remains unclear. The role of foreign-origin cases on local dengue epidemics thus has been largely neglected by research. This study investigated the effect of both imported dengue and local meteorological factors on the occurrence of indigenous dengue in Taiwan. (Shang et al., 2010). In addition, These results importance of temperature and precipitation in the transmission of dengue viruses and suggest a reason for their spatial heterogeneity. Considering that climate integrates the factors that define seasonal transmission and establishes if dengue cases are endemic, epidemic or outbreaks (Gómez-Dantés et al. 1995), these results may be useful in the development of early warning system (EWS) based on climatic elements for prevention and control of dengue epidemics in the municipalities of Veracruz studied, as proposed by WHO (2004) and then climatic forces may work in parallel with socio-cultural and epidemiological conditions. Larvae breeding sites may be a result of poor housing, water scarcity-related behaviour, in addition to the lack of garbage collection facilities and weak health institutions, all of which create the broth supporting the re-emergence of dengue and other global calamities (Garret 1994; Cifuentes et al. 2006). Climatic forces may work in parallel with socio-cultural and epidemiological conditions. Larvae breeding sites may be a result of poor housing, water scarcity-related behaviour, in addition to the lack of garbage collection facilities and weak health institutions, all of which create the broth supporting the re-emergence of dengue and other global calamities (Garret 1994; Cifuentes et al. 2006).

Further studies are needed to validate an EWS that incorporates the factors that affect dengue transmission. Currently, more than 300 districts are reporting cases and more than 200 million people living in urban and rural areas are at risk, although the some interventions have been done, but DHF cases still in public health problems in Indonesia. It also recommend strengthening environmental, health and entomological surveillance systems to improve preparedness and emergency responses longitudinal study contributes to a better understanding of the complex dynamics of weather, human behavior, mosquito vectors and dengue virus transmission in an endemic country. It is important for decision maker to evaluate DHF program, improvement community awareness about PHEIC (public health emergency of international concern). Alert, response and capacity building under the International Health Regulations (IHR) and strengthening national capacities for epidemic preparedness and response in support to the national implementation for DHF prevention program. Intensified surveillance and control of mosquitoes during periods with high rainfall are recommended. Notably, its sustainability will largely depend on the ability of the meteorology center to improve climate predictions. Thus, from one of research recommend future studies using similar methods of more municipalities with different geographical location and climate.(Hurtado-Díaz et al., 2007). Early detection and case management of imported cases through rapid diagnosis may avert large-scale epidemics of dengue/dengue hemorrhagic fever. The deployment of an early-warning surveillance system, with the capacity to integrate meteorological data, will be an invaluable tool for successful prevention and control of dengue, particularly in non-endemic countries.(Shang et al., 2010).

Summary

Conclusion

From the research results obtained, there is a correlation analysis between rainfall and DHF (pv = 0,001 and r = 0,358) and not significant relationship between rainy days and DHF (pv = 0,079 and r = 0,174). However, both of them showed a positive pattern.

Suggestion

1. Intensified surveillance and control of mosquitoes during periods with high rainfall are recommended.
2. The result of research that will need policy to implement EWARS in Health Department, to prepare adaptation and mitigation specially for vulnerable populations, giving the IHR to the decision maker, to improve community awareness about PHEIC.
3. The deployment of an early-warning surveillance system, with the capacity to integrate meteorological data, will be an invaluable tool for successful prevention and control of dengue, these results may be useful in the development of early warning system (EWS) based on climatic elements for prevention and control of dengue epidemics

Acknowledgments

The author wishes to acknowledge the financial support of the research centre Sriwijaya University. Grateful appreciation is extended to the local health department units, health communities in health municipal and residents of the communities of Palembang and all others who have supported this study in one way or another.

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