WORLD CONFERENCE ON CLIMATE CHANGE AND HUMANITY

VIENNA, AUSTRIA

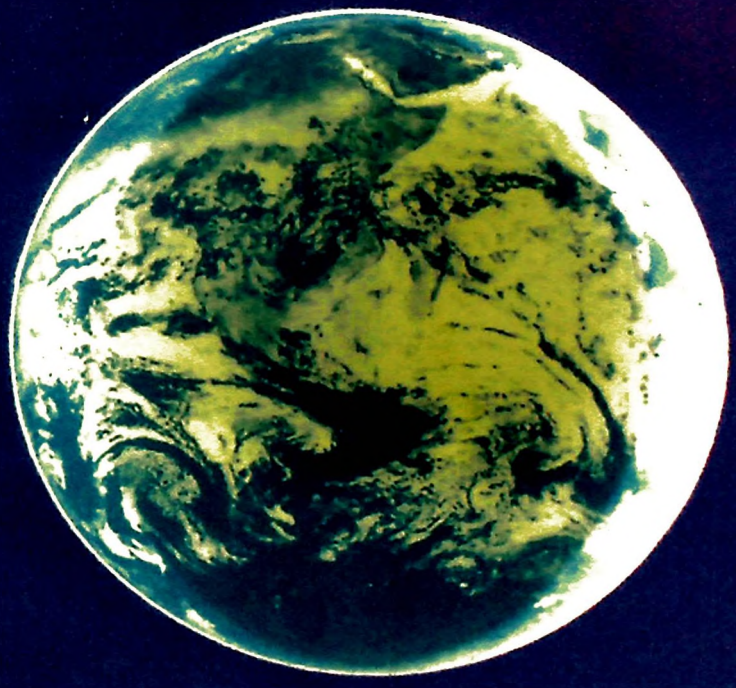
14-15 JUNE 2012

PROF. MADYA DR. HALIZA ABDUL RAHMAN
PPSK

WORLD CLIMATE 2012

World Conference on Climate Change and Humanity

14-15 June 2012



Vienna University of Technology

Room Erzherzog Johann (1040 Wien, Erzherzog Johann Platz
(= Gusshausstraße 30) 5 floor

CLIMATE CHANGE AND DENGUE FEVER DISEASES: ANY ASSOCIATION?

Haliza Abdul Rahman
Assoc. Prof.
Environmental & Occupational Health Programme
School of Health Sciences, Universiti Sains Malaysia
16150 Kubang Kerian, Kelantan, MALAYSIA.
Email: haliza@kb.usm.my

ABSTRACT

Climate change is incurring lots of unintended consequences for health worldwide which dengue fever is among the top of those diseases. Climate change is accelerating the spread of dengue fever worldwide which by 2085, an estimated 52 percent of the world's population or about 5.2 billion people will be living in areas at risk of dengue. In 2008 alone, dengue fever and its complications cause 50 to 100 million infections and 22,000 deaths annually in more than 100 countries. Climate change would directly affect disease transmission by shifting the vector's geographic range and increasing reproductive and biting rates and by shortening the pathogen incubation period. The objective of this paper is to determine association between climate change and dengue diseases. For this purpose, published papers from journals, thesis and book on climate change and dengue diseases were searched and reviewed. In conclusions, there are many factors that could explain the growth in the number of cases of dengue, but surely increases in temperature and precipitation because of climate change is the most important factor contributing to this phenomenon.

Key words: climate change, impact on health, dengue disease, public education and awareness

INTRODUCTION

Climate change refers as a statistically significant variation in either the mean state of the climate or in its measurable variability, persisting for an extended period (typically decades or longer). Climate change is indeed tangible: the worldwide mean surface temperature has increased by 0.74±0.18°C over the past 100 years, while the worldwide sea level has risen by 1.8 mm per year since 1961 and the Arctic sea ice is retreating by 2.7±0.6% per decade. In addition, sea surface temperatures are warming,

mountain glaciers are shrinking, oceans are becoming more acidic, extreme weather events are increasing in frequency and intensity (Semenza & Menne 2009).

Climate change is ascribed to natural processes and human activity altering atmospheric conditions. Accelerating economic activity and fossil fuel combustion over the last century have precipitated an environmental impact of unprecedented proportions. Ecosystem decline, loss of biodiversity, stratospheric ozone depletion, and climate change are some of these environmental changes. These climatic changes have already had noticeable effects on many natural systems, including marine and terrestrial ecosystems, such as the timing of seasonal biological events and the distribution of animal and plant species. According to Ban Ki-Moon (UN Secretary General), climate change is expected to cause more severe and more frequent natural hazards. As our cities and coasts grow more vulnerable, these hazards can lead to disasters that are far worse than those we have seen to date.

The impact of climate change includes: (i) higher temperatures (some estimates suggest that the average temperature will increase by 6 degrees Celsius by the end of the century) leading to sea level rise; (ii) more frequent cyclones and droughts; and (iii) the rapid growth of various life forms (such as mosquitoes) which carry diseases. Of greater concern is the discovery that some of the changes associated with climate change are occurring at a faster pace than had been projected. Some of the changes projected by scientists to occur in 2080 are already occurring in 2008. For example, diseases such as the West Nile virus, formally confined to the tropics, have now been

found in the temperate zone such as in the northern United States and Canada (Climate Ark 2008).

Climate change is likely to impact disproportionately upon the poorest countries and the poorest persons within countries, exacerbating inequities in health status and access to adequate food, clean water and other resources. Death rates for the world's poor will rise by 2030 as a result of Global Warming-related illnesses of malnutrition and diarrhea. By 2080, increase in people chronically hungry will achieve 200 to 500 million due to Global Warming (IPCC 2007).

Due to that, climate change is incurring lots of unintended consequences for health worldwide which dengue is the top among those diseases. Since the 1970s climate change had contributed to 150,000 more deaths every year from disease, with over half of the deaths in Asia. In 2008, the World Health Organization (WHO) warned that the health of hundreds of millions of people might be put at risk by the effects of climate change (Figure 1). The WHO regional director, Dr Shigeru Omi, said that global warming had already impacted on lives and health and that this problem would pose an even greater threat to mankind in coming decades unless action was taken.

The impact on health from climate change may be far reaching and include deaths and hospitalizations due to heat waves; hypothermia from blizzards; injuries and death from flooding; and potential shifts in the transmission ranges of vector-borne

diseases such as hantavirus, West Nile virus, tick-borne encephalitis, Lyme disease, Malaria and Dengue. Most importantly, the potential population health impacts of environmental changes extend far into future, if environmental conditions deteriorate further. Change can be abrupt and unexpected but they can also be protracted and

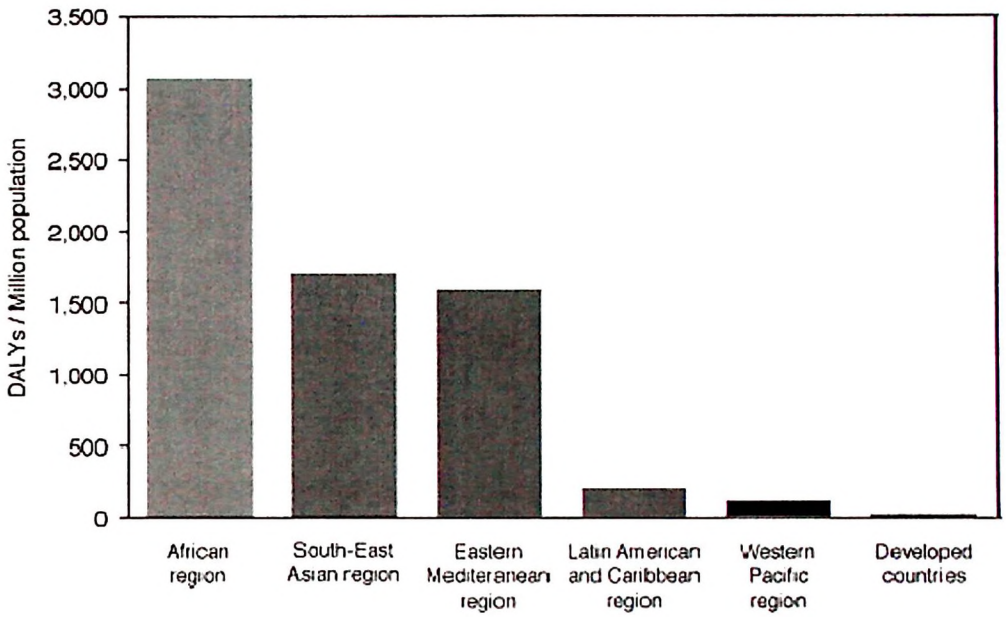


Figure 1: Estimated health impact of climate change (1990–2000) by region

Calculated for Malaria, Malnutrition, Diarrhoea and Floods.
DALYs are a parameter for the cumulated burden through diseases [Disability-Adjusted Life Years represent the loss of healthy or productive life years (WHO, 2002). This cumulative measure has been developed as an indicator of a population's total disease burden (premature mortality, disease and disability; Murray, 1994)]

Source: Campbell-Lendrum et.al 2003; www.wbgu.de/.../sn_2003_en_figures/Fig_2-1-2.gif

gradual and thus pose considerable challenges to public health (http://ecdc.europa.eu/en/healthtopics/climate_change/Pages/index.aspx).

OBJECTIVES

There are three objectives in this study. They are:

1. To determine association between climate change and dengue diseases.
2. To examine whether another factor will be contributing in increasing of dengue fever cases.
3. To stress the importance of public roles to fight dengue threat.

METHODOLOGY

This study involved with secondary data. Therefore, the study was based on secondary information data collected from journals, thesis and book on climate change and dengue diseases.

ANALYSIS AND FINDINGS

i) Climate Change and Health

The relationship between climate change and human health is very complex. There are direct impacts, such as temperature-related illness and polluting spores and moulds. Other impacts are more indirect and lead to water and food-borne diseases, vector-borne and rodent-borne diseases, or food and water shortages (Landon 2006).

From ancient Greek times, Hippocratic ideas about air, water and place stressed the crucial role of the environment on health outcomes. By the sixteenth and seventeenth centuries, the existence of a connection between health and the environment had become generally recognized. Good air and the elimination of foul

smells were felt to be particularly important, and a healthy environment was thought to produce healthy food and drink (Landon 2006).

Recently, the role of the environment on the burden of disease is significant; the environment has been implicated in 21 per cent of the overall burden of disease world-wide (Landon (2006). According to the report of the World Health Organization (WHO) Commission on Health and Environment (1992) *Our Planet, Our Health,* "The conditions in which environmental factors are most prominent are tropical diseases (such as dengue), which to a large extent are caused by infection by parasites requiring one or more intermediate hosts and vectors for their development" (http://www.ciesin.org/TG/HH/veclev3a.html).

Climate change is one of many important factors driving infectious disease spread, alongside human and animal population dynamics, intense global levels of trade and travel, changing patterns of land use, and so on. Predicting the effects of climate change on health requires an examination of the current incidence and distribution of major vector-borne diseases. Many infectious agents, vector organisms, non-human reservoir species, and pathogen replication rates are particularly sensitive to climatic conditions. Numerous theories have been developed in recent years to explain the relationship between climate change and infectious diseases: they include higher proliferation rates at higher temperatures, extended transmission season, changes in ecological balances, and climate-related migration of vectors, reservoir hosts, or human populations (Semenza & Menne 2009).

Climate change may also alter the distribution and transmission of communicable diseases principally through impacting disease pathogens directly; through impacting the distribution of vectors which may carry diseases; or through impacting human behaviours leading to changing patterns of exposure to infectious diseases (e.g. increased time spent outdoors in woodlands where ticks live). Vector-borne diseases are transmitted by arthropods such as ticks (e.g. tick-borne encephalitis (TBE), Lyme disease), mosquitoes (e.g. Chikungunya fever, Dengue fever), or sandflies (e.g. visceral leishmaniasis). Climatic changes, such as hotter and longer summers, warmer winters, and/or increased annual rainfalls could enable these organisms to shift their habitats, potentially introducing diseases to areas previously unfamiliar with them (http://ecdc.europa.eu/en/healthtopics/climate_change/Pages/index.aspx).

ii) Climate Change and Dengue Fever

Global climate change might expand the distribution of vector-borne pathogens in both time and space, thereby exposing host populations to longer transmission seasons, and immunologically naive populations to newly introduced pathogens (Patz & William 2001). Climate change is accelerating the spread of dengue fever worldwide. By 2085, an estimated 52 percent of the world's population or about 5.2 billion people will be living in areas at risk of dengue. Worldwide, in 2008 alone, dengue fever and its complications cause 50 to 100 million infections and 22,000 deaths annually in more than 100 countries (Zabarenko 2009). In 2010, in Asia, according to data collected by

the UN body, the highest number of reported cases to August are in Indonesia (80,065) followed by Thailand (57,948) and Sri Lanka (27,142) (Rupam 2010). Formerly under control in some parts of the world, the mosquito-borne disease has made a rapid resurgence in recent decades, leading scientists to put dengue on par with better-known killers like malaria and the Ebola virus as a global health threat (Handwerk 2006).

Dengue is a disease caused by any one of four closely related viruses (DEN-1, DEN-2, DEN-3, or DEN-4). Dengue virus infections are transmitted by the bite of an infected *Aedes* mosquito. Mosquitoes become infected when they bite infected humans, and then they transmit that infection to other people they bite. Two main species of mosquito, *Aedes aegypti* and *Aedes albopictus*, are responsible for all cases of dengue transmitted worldwide. Symptoms appear 3 to 14 days after the infective bite. Dengue fever is a febrile illness that affects infants, young children and adults. Symptoms range from a mild fever, to incapacitating high fever, with severe headache, pain behind the eyes, muscle and joint pain, and rash. Dengue fever can be diagnosed with two blood tests, two to three weeks apart. The tests can show whether a sample of blood contains antibodies to the virus. During an epidemic, when many people are falling ill with dengue, a health care provider often can diagnose dengue based on the typical signs and symptoms. The dengue virus can sometimes be isolated from blood samples or tissue biopsies, but usually only when symptoms are of recent onset.

Rising temperatures and higher rainfall caused by climate change will see the number of mosquitoes increasing in cooler areas where there is little resistance or

knowledge of the diseases they carry. Climate change threatens to further exacerbate the spread of many infectious diseases because increases in heat, precipitation and humidity can foster better conditions for tropical and subtropical insects to survive and thrive in places previously inhospitable to those diseases.

There are many factors that could explain the growth in the number of cases of dengue, but surely increases in temperature and precipitation because of climate change. Cold temperature kills adult mosquitoes, including their larvae, limiting the population of dengue carrying mosquitoes. However, global warming has disrupted this natural procedure, resulting to increased mosquito populations and consequently of dengue worldwide.

Furthermore, dengue diseases will spread once climate change forces people to flee their homes, such as low-lying islands or coastal land swamped by rising sea levels. For example, in the Pacific nation of Tuvalu, a ring of nine Polynesian islands, several thousand people have already left for New Zealand to restart their lives because of rising seas. The number of environmental refugees as a whole may reach 50 million by 2010, with small, low-lying island populations at the greatest risk. Displaced people from lowland areas could well provide the human reservoir for the spread of malaria and dengue (Perry 2008). Thus, the costs, in terms of human lives lost, are beginning to worry the WHO. For examples (Barclay 2007):

- In Malaysia, dengue fever has increased dramatically from less than 1000 cases in 1973 to about 46 000 cases in 2007. Therefore, health authorities

have waged an aggressive battle to curb the spread of the disease, with 43,543 people infected and 128 deaths from January to 29 November 2010 compared with 37,278 cases and 78 deaths during the same period in 2009. (News 2010).

- In Indonesia, reported dengue cases doubled in 2007 compared to 2005
- The number of cases reported in the Americas increased from 66,000 in 1980 to 552,000 in 2006, according to the Pan American Health Organization. Brazil, Paraguay, and the Dominican Republic have all had serious epidemics in recent years.
- Nearly 4,000 cases of imported and locally transmitted dengue fever were reported in the United States by the Centers for Disease Control and Prevention between 1995 and 2005; if cases along the Texas-Mexico border area are included, that number rises to 10,000 (Zabarenko 2009).
- In Mexico dengue cases have increased by more than 600 percent since 2001, according to Mexico's National Center for Epidemiology and Disease Control.
- The South Pacific's scattered island nations of Samoa, Tonga, New Caledonia, Kiribati, New Caledonia and Palau are currently struggling with an endemic of dengue, with more than 2,000 cases so far recorded in 2008 (Michael 2008).
- Modelling showed that dengue fever could increase by 20 to 30 percent in Fiji due to climate.

The higher temperatures globally contribute to the spread of dengue in several ways. First, it speeds up viral incubation in the mosquito. Second, it shortens the mosquito breeding cycle. Third, it increases mosquito feeding frequency. And all these lead to the more efficient transmission of the dengue virus from the mosquitoes to humans.

Warmer temperatures boost the speed of development of adult mosquitoes, increasing their numbers. Female mosquitoes bite more frequently in hotter temperatures, and warmer winters enable mosquitoes to survive in areas that were formerly too cold. Higher temperatures also shorten the time it takes for the virus inside the mosquito to develop and become infective (Climate Progress 2009).

In coming the years, there will be an increasing number of people who live in dengue risk regions. An estimated 50 millions dengue infections occur every year, including 500,000 cases of dengue haemorrhagic fever (DHF) that require hospitalization which is equivalent to approximately one DHF case every minute. At least 21,000 deaths from DHF occur every year, mostly among children – equivalent to one young life lost to DHF almost every 20 minutes. These statistics will become worse unless urgent and effective actions to be undertaken to avert from such risks (WHO 2009).

Although climate may play a role in changing dengue incidence and distribution, it is one of many factors; given its poor correlation with historical changes in incidence, its role may be minor. Other important factors potentially contributing to global changes in dengue incidence and distribution include population growth, urbanization, lack of sanitation, poor water storage, increased long-distance travel, ineffective mosquito control, and increased reporting capacity. These factors provide an increase in the breeding habitats of the mosquito.

PUBLIC ROLES IN COMBATING DENGUE DISEASE

Currently, there is no available vaccine, and development of a vaccine may or may not immediately translate into widespread use due to the high costs of introducing a new vaccine in a population. Therefore, the most important strategy in the prevention and control of dengue lies in the control of its vector, the *Aedes* mosquito. Hairi et al. (2003), said due to the absence of vaccine or a cure, the only effective measure available to prevent and control dengue is by requiring support, cooperation and participation by the community. For that reason, level of knowledge, attitude and practice related to dengue fever prevention among public is very important.

The urgent need for alternative approaches has become obvious and community participation is frequently invoked or advocated as a key element to achieve effectiveness and sustainability (Gubler & Clark 1996). Because of that, the ministry of Health is concern with this problem plus there are many implementation involved

newspaper and broadcasting as conveying information to the public. For example, health articles, health advertisement, posters, pamphlet and booklet, campaigns, health visits and health education provided to increase public's knowledge about dengue.

CONCLUSIONS AND RECOMMENDATIONS

Climatic factors influence the emergence and reemergence of infectious diseases, in addition to multiple human, biological, and ecological determinants. Climatologists have identified upward trends in global temperatures and now estimate an unprecedented rise of 2.0 degrees C by the year 2100. Of major concern is that these changes can affect the introduction and dissemination of many serious infectious diseases. The incidence of mosquito-borne diseases, including malaria, dengue, and viral encephalitides, are among those diseases most sensitive to climate. Climate change would directly affect disease transmission by shifting the vector's geographic range and increasing reproductive and biting rates and by shortening the pathogen incubation period (Patz et al. 1996).

Speculations on the potential impact of continued warming on human health often focus on mosquito-borne diseases such as dengue. To prove it, the literature to date indicates that there is a lack of strong evidence of the impact of climate change on vector-borne diseases such as dengue and malaria. Climate change could alter the incidence and geographical range of climate-sensitive dengue largely confined to

worldwide, it is expected to impact the environment for population health-system planning processes.

Therefore, the health authority around the world has been working continuously with the public to reduce the spread of mosquito breeding areas. But this may not be enough. Perhaps an integrated approach which takes in other sectors such as sanitation, drainage, tourism development as well as greater public awareness holds the key to reducing the potential threat from dengue fever and other related diseases. In short, interventions through community responses, planning by means of public education and awareness campaigns on climate change is effective in reducing the risk of vector-borne diseases such as dengue.

Climate change will make the situation of dengue disease more acute, especially when the present control measures concentrating on the *Aedes* mosquito vectors have not been effective. Therefore, awareness among public is the most important factor to fight against climate change on a national and global scale because climate change awareness helps people who could potentially be impacted by climate warming to prepare themselves. In an effort to increase public awareness for climate change it is essential that communication strategies be used that are capable of drawing out personal behaviour change. In addition, understanding the linkages between climatological and ecological change as determinants of disease emergence and redistribution will ultimately help optimize preventive strategies.

REFERENCES

Gubler, D.J and Trend, D.W. 1996. Community involvement in the control of Aedes Aegypti. *Anta Tropica.* 61: 169-179.

Gubler, Duane J. Dengue and dengue hemorrhagic fever. *Clin. Microbiol.* Rev. 1998. 11: 480-496.

Hairi, F. Ong, C.H. Suhaimi, A. Tsung, T.W, Anis Ahmad, M.A. 2003. A knowledge, attitude and practice (KAP) study on dengue among selected rural communities in the Kuala Kangsar district. Asia-Pacific journol of Public Health. 15:37-43.

http://www.ciesin.org/TG/HH/veclev3a.html. Current Status of vector-borne diseases around the World

http://ecdc.europa.eu/en/healthtopics/climate_change/Pages/index.aspx. Climate change in Europe. European Centre for Disease Prevention and Control.

Landon, M. 2006. Environment, health and sustainable development. Berkshire, England : Open University Press.

Nobuchi, H. The symptoms of a dengue-like illness recorded in a Chinese medical encyclopedia. *Kanpo Rinsho.* 26:422-425. 1979. (In Japanese.) Cited in Gubler, Duane J. Dengue and Dengue Hemorrhagic Fever. *Clin. Microbiol.* Rev. 1998 11: 480-496

Patz, J. A., P. R. Epstein, T. A. Burke and J. M. Balbus. 1996. "Global climate change and emerging infectious diseases," Journal of the American Medical Association, Vol. 275, No. 3, January 17, pp. 217-223.

Semenza JC, Menne B. Climate Change and Infectious diseases in Europe. Lancet ID. 2009;9:365-75.

Patz, Jonathan A. and William K. Reisen. 2001. "Immunology, climate change and vector-borne diseases," Trends in Immunology, Vol. 22, No. 4, pp. 171-172.

WHO. 2009. Dengue and dengue haemorrhagic fever. WHO 2009; 117.