CLIMATE CHANGE AND THE RISE OF CLASSIC DENGUE FEVER CASES TRANSMITTED BY AEDES AEGYPTI IN A RURAL COMMUNITY OF NORTHERN COSTA RICA

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ABSTRACT

Vector-borne diseases have been increasing by the same variations in climate, favoring the adaptive process of the life cycle of these disease-transmitting vectors. Aides Aghyptie mosquito, which transmits Classic Dengue Fever, usually develops below an average altitude of 1,200 meters above sea level, its larvae develop optimally occurs between 77 ° F and 84 º F. Since 1993, in Costa Rica it is considered as a Reemerging Disease and a seasonal pattern with increased incidence during the rainy season as it has been described. By the year 2009, there has been an increase in Breteau Index (index for larval presence) in the rural community of San Carlos compared to previous years. An increase in the incidence of cases of dengue fever during the rainy season has been described; however, the area posses different climatic and geographic characteristics to the areas of highest incidence in the country.

Key Words: climate change, Dengue Fever, rural community

INTRODUCTION

There are several mechanisms for the transmission of vector-borne diseases. A vector is generally defined as an agent that serves as a means of transmitting a pathogen from one organism to another. Among these diseases, it is possible to include: Dengue Virus, West Nile Virus, Malaria and Yellow Fever, all of the above are transmitted by mosquitoes, Avian influenza disseminated by birds, Typhoid, Dysentery and Cholera whose transmission is attributed to the housefly and more complex diseases like the Bubonic Plague associated to fleas.

Dengue is an infectious viral disease transmitted by the Aedes mosquito Aeghypti (Mandel, 2010). There are four variants of the dengue serotypes 1, 2, 3 and 4, according to their antigenic and genetic characteristics (Ross, 2010).

Classic dengue is characterized by an acute febrile illness accompanied by characteristic symptoms such as headache, eye pain, fatigue, mild respiratory symptoms, gastrointestinal symptoms, myalgia (muscle pain) and arthralgia (joint pain). The incubation period ranges

from 3 to 14 days and the fever usually lasts 5 to 7 days. It affects all age groups, but older adults and children are more susceptible and show a higher risk of complications or death (Ferri, 2010). As it has been reported up to 90% of patients with Dengue Hemorrhagic Fever are children under 15 years of age *(Gurugama, 2010).*

It is common to find cases of dengue in the tropics *(Wilder- Smith, 2008)*, in an area between latitudes ranging 35 degrees north and 35 degrees south *(Ross, 2010).* An estimated from 2 to 5 billion people are at risk for infection in tropical and subtropical countries, especially in the Southeast and South Asia, Central and South America and the Caribbean *(G,Malavige, 2004*). Population growth and subsequent demographic and social changes have led to an increase in mosquito density *(McCall,2008).* Migration and movement of individuals through air travel have contributed to the current geographical distribution of the disease. *(Webster, 2010)*. Climatic factors also favor the appearance of the disease in areas that previously were not suitable for survival and reproduction. These areas now become common places to consummate their life cycle (*P. Perera, 2010*).

Currently there is no vaccine available against Dengue, and case management is oriented to the alleviation of symptoms. The fact that there is no specific antibiotic for treatment makes prevention the most important measure to prevent it in endemic areas. (*CDC; 2010*)

By 2008, it was estimated that the Caja Costarricense de Seguro (Costa Rican Social Security System) had invested about 1.97 million dollars in disability and patient care. The cost of the social impact of the disease that affects the family unit and increases the susceptibility of infected patients to suffer more severe forms of the disease should be also added to this estimate.

COECOCEIBA (2008), an Environmentalist Organization, refers to the existence of elements of climate change affecting the geography and the environment in general. Changing patterns of rainfall and humidity, increased frequency and intensity of hurricanes (increasing particularly in the Caribbean and influencing the north of Costa Rica), melting and increased sea temperatures, low productivity of the seas, loss of biodiversity. Within the social impacts: both: agriculture and vulnerability levels of communities will be affected in different ways. Incidence of pests and diseases such as Malaria and Dengue that are common in warm areas, are now increasing their impact range. This situation of new impacts has already been registered in the tropics.

The International Union for Conservation of Nature (IUCN) has released a concept that attaches to the ability of certain diseases exacerbated by climate change processes, with the possibility of appearing in unusual areas and increasing the amount of affected people and animals and hence the economy. These diseases are known as the "Deadly Dozen": Tuberculosis, Rift Valley Fever, Sleeping Sickness, Red Tides, Avian Flu, Babesia, Cholera, Ebola, Yellow Fever, Intestinal Parasites, Lyme Disease and Plague. This list confirms not only that climate changes are affecting directly the behavior of the disease and its evolution, but also that vectors have a greater adaptive capacity and they are able to transmit half of these deadly dozen diseases.

All over the world, a registered ranging average from 50 (*Ross, 2010*) to 100 million cases of dengue infection each year is increasing (*CDC, 2010*). Over the past 22 years, the American Region has had an increasing tendency in the incidence of dengue (*San Martín JL,2007*). Up to the Epidemiological Week (EW) No. 45 of 2009 there were 853,468 reported cases of Dengue in the Americas, including 20,832 cases of Dengue Hemorrhagic Fever and complicated forms of Dengue and 326 deaths, a regional fatality rate of 1.56 % (*OMS, 2009*).

As indicated by the Costa Rican Ministry of Health, in the second submission 2009 on Climate Change, Dengue Fever prevails as a disease with high sensitivity in human populations due to its relationship with climate.

Several studies have shown a positive correlation between mosquito density and rainfall, while a study in Thailand showed that the increase in mosquito density was rather attributable to temperature and humidity (*Gubler, D, 2008*), since the temperate and humid climate

shortens the viral replication within the female mosquito (*J. Wijewickrama, 2010*)

Costa Rica was an Aedes Aeghypti free country for many years, until 1992, when the vector was reintroduced into the country, it was detected in locations that were historically free of this vector, as the communities of the Central Plateau, located at altitudes above 700 meters above sea level. (*Barquero, F, 2009*)

In the year 2010, up to the epidemiological week No. 30 the country recorded a total of 17,342 dengue cases, representing an increase of 631.4% over the accumulated 30 weeks of the year 2009 (*Ministerio de Salud, 2010*).

The North Zone is located among the sections of the country with less economic development and has only 4.6% of GDP, according to the National Institute of Statistics and Census. By 2010, the National Meteorological Institute reported an increase in precipitation in the North Zone on a relative historical average over twelve months. This coincides with an unusual increase of cases of classical dengue in Ciudad Quesada, and an index Breteau in 3.4, compared to previous years in which the Ministry of Health has reported zero. The focus of this study corresponds to this urban community that historically has shown fewer cases due to its geographical and climatic features.

OBJECTIVE

This study aims to describe the Dengue outbreak in the community of Ciudad Quesada, in the North Zone of Costa Rica.

This analysis corresponds to a cross-sectional descriptive study. Cases were established and defined as a registered patient in the database of the local Information System of Epidemiological Surveillance (SISVE) used by the Caja Costaricense de Seguro Social (Social Security System)

Frequency estimates were estimated by sex, age range, symptoms and place of consultation. Epi Info Statistical software was applied to obtain the epidemic curve for time location of cases. The prevalence ratio (PR) was estimated to determine a possible association by age, sex and location. Using Arc View GIS 3.2 a map was designed to identify the geographic location of cases. An Epidemic curve analysis was applied to data from 2007 to 2010 (data available), for the distribution of cases over time.

RESULTS

- Classic Dengue cases have been present annually. Even though the time series 2007-2010 shows a slight upward trend of cases in recent years (Table 1).
- It was possible to identify a total of 31 cases, with a peak in the epidemiological week No. 23.
- The primary attack rate corresponded to 6.7 per 10.000 inhabitants.
- A 53% of cases were male patients with a of most often age range from 40 to 49 years, corresponding to 28.1% (95%: 13,7-46, 7).
- Los Angeles was the site where the highest number of cases occurred with a 34.4% (95% CI 18.6 to 53.2), which showed a prevalence ratio (PR) of 1.44 (95% CI: 1.1-1, 9) in relation to other communities.
- The symptoms present among cases were fever, headache, rash, eye pain and abdominal pain.

- There were a total of 31 cases of Dengue in 2010; they were concentrated from the epidemiological week number 18.

Table 1. Characteristics of cases of dengue, Health Area of Ciudad Quesada, San Carlos, Costa Rica, 2010.

Chacteristics	Cases	%	CI 95% Lower Limit	CI 95% Upper Limit
Sexo				
Femenino	15	46,90%	29,10%	65,30%
Masculino	17	53,10%	34,70%	70,90%
Ages (years) n=32				
0 a 9	3	9,40%	2,00%	25,00%
10 a 19	5	15,60%	5,30%	32,80%
20 a 29	4	12,50%	3,50%	29,00%
30 a 39	6	18,80%	7,20%	36,40%
40 a 49	9	28,10%	13,70%	46,70%
50 a 59	4	12,50%	3,50%	29,00%
60 a 70	1	3,10%	0,10%	16,20%
Average age =32,7 (CI95%: 31,2-34,1)				

The Equipo Basic de Atención Integral en Salud (Local Clinics) also known as EBAIS with the highest number of cases was Los Angeles. The distribution of EBAIS is shown in Table 2.

Table 2. EBAIS cases by consultation, the Health Area of Ciudad Quesada, San Carlos, Costa Rica, 2010.

Site	Cases (n=32)	%	IC 95% Lower Limit	IC 95% Upper Limit
Los Angeles	11	34,40%	18,60%	53,20%
Cuidad Quesada	5	15,60%	5,30%	32,80%
San Pablo	4	12,50%	3,50%	29,00%
Palmera	3	9,40%	2,00%	25,00%
San Martín	3	9,40%	2,00%	25,00%
Sucre	3	9,40%	2,00%	25,00%
Cedral	2	6,30%	0,80%	20,80%
Concepción	1	3,10%	0,10%	16,20%

Figure 2. Cases of dengue in the Area Health Ciudad Quesada, San Carlos, Costa Rica 2010.

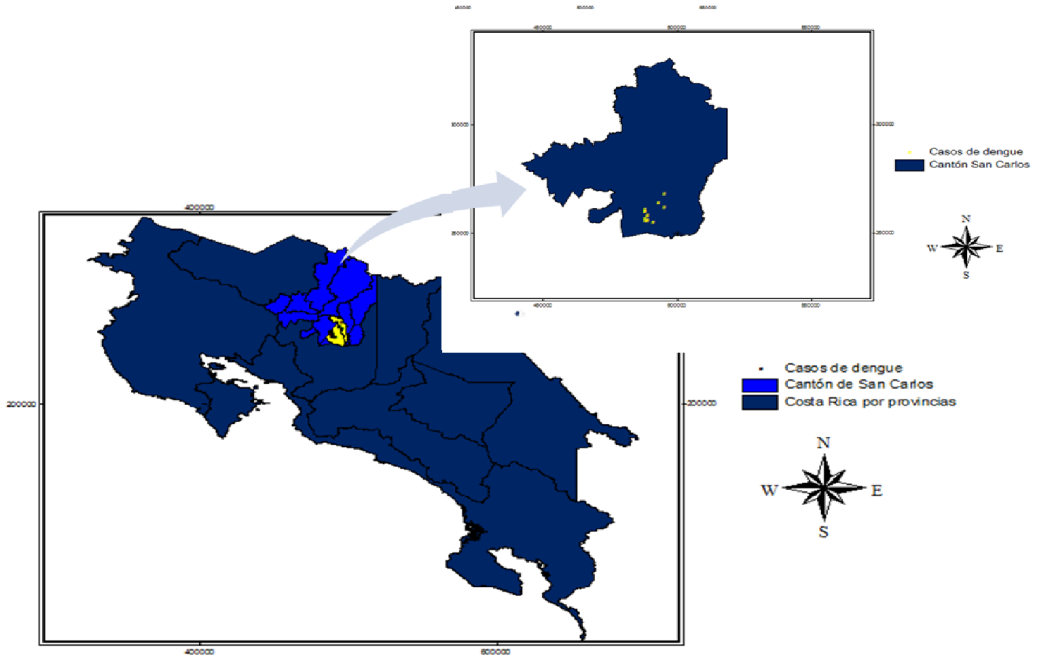


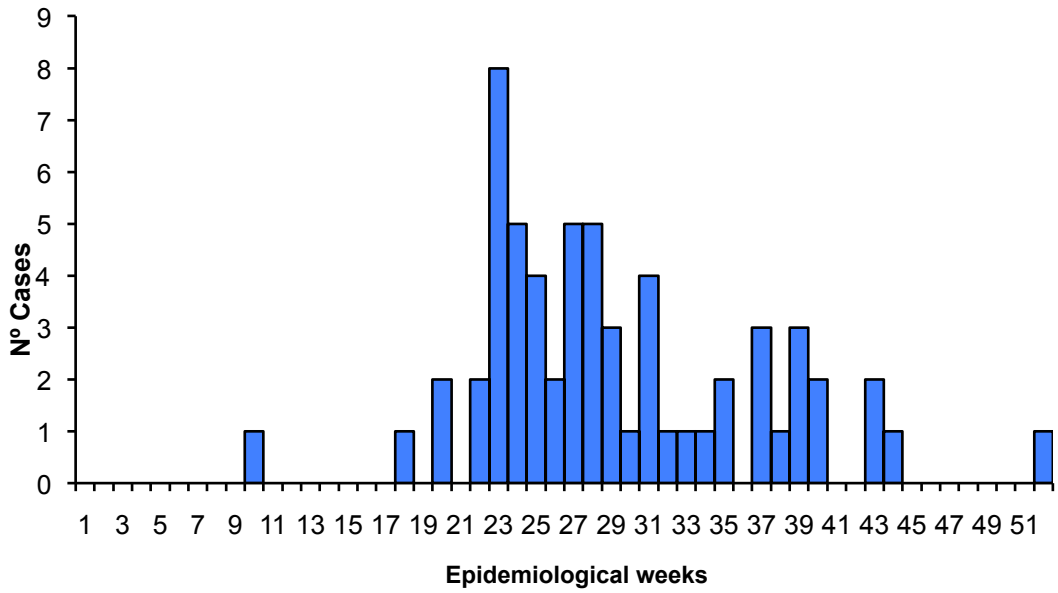
Table 3, shows that there is probably an association between living in the city of Los Angeles and suffering from dengue fever. It is no evidence of association between sex and age.

Table 3. Prevalence ratio for age, sex and location on the Area de Salud de Ciudad Quesada, 2010.

Variable	Prevalence Ratio (PR)	CI 95% Lower Limit	CI 95% Upper Limit
Age			
From19 to 64 years	1,024	0,9528	1,1005
From 1 a 18 y to 65 or more	*		
Gender			
Female	0,9828	0,9156	1,055
Male	*		
Sites			
Los Angeles	1,4411	1,1079	1,8745
Resto de Localidades	*		

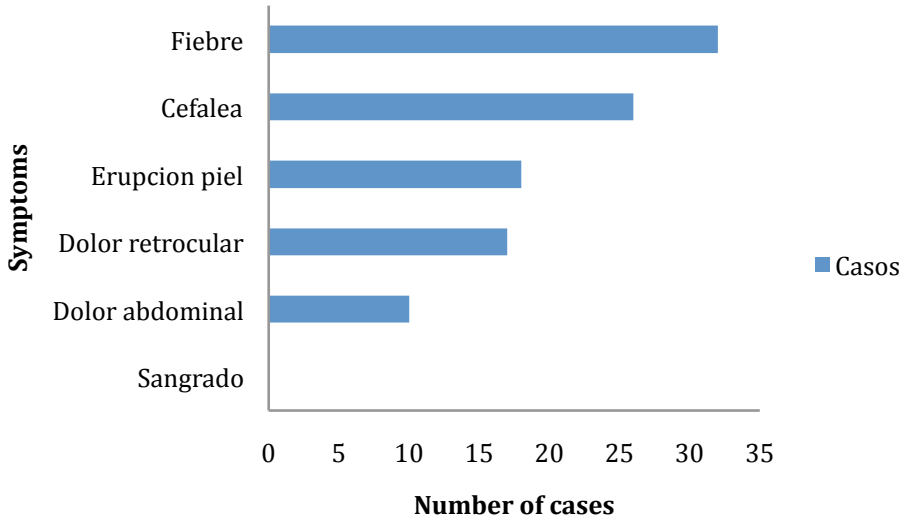
Figure 3 shows the epidemiological curve, with cases of dengue since 2007, through week 27 of 2010, shown in. The red marks show the beginning of the outbreak of dengue in week 18 of this year. The peak cases correspond to week 23.

Figure 3. Number of Cases of dengue, Area de Salud Ciudad Quesada, San Carlos, Costa Rica, 2010.

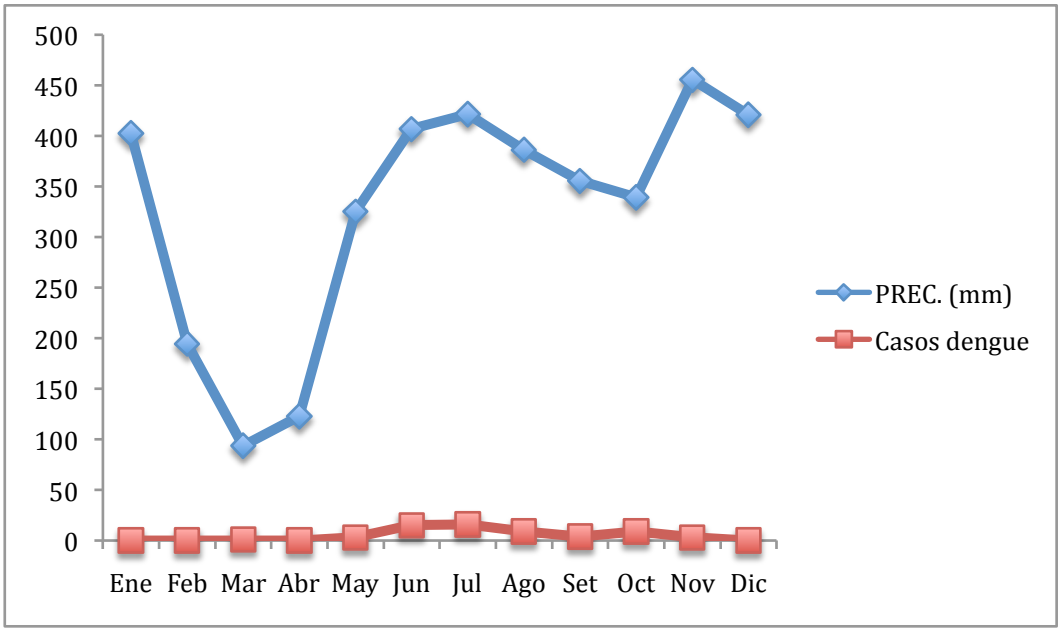


The symptoms experienced by the cases are shown in Figure 4

Figure 4. Symptoms shown by dengue cases, Área de Salud Ciudad Quesada, San Carlos, Costa Rica 2010.



The peak of the outbreak appears to be related to months with higher average rainfall, as shown in Figure 4.



Source: Precipitation media: National Meteorological Institute.

The average monthly temperature was not included because it remains constant over the months and it ranges between 68.99 ° F to 72.7 ° F.

DISCUSSION AND CONCLUSIONS

- The dengue outbreak peaking in week 23 affected equally men and women of the town.
- As described in the literature, there was no clearly susceptible age group, although almost half the cases (46.9%) occurred in people between 30 and 49 years old. There are cases reported in children, which should be thought as an age group of potential risk for developing complications from dengue hemorrhagic fever.
- The problem was focused mainly in Los Angeles, showing that there was a stronger association between cases of dengue, compared to other localities in the area. There was evidence of an area of high transmission.
- It is important to prioritize prevention and elimination of mosquito in this community, especially in areas where there are concentrations of people (schools, bus stations, hospitals, health centers, etc.) (*CDC, Julio 2010*).
- The outbreak started in week 18 with the index case report and thereafter, there was an increase of cases, mainly at week 23, then there was an apparent decline, however, the database had data up to week 27.
- The symptoms experienced by the cases are consistent with those reported in the literature. All patience experienced fever and headache.

- It seems that the number of cases increases with the average monthly rainfall, however, it would be important to study further back, to identify whether or not the rainfall level is a risk factor that triggers dengue outbreaks and also other studies related to temperature and humidity.

- Prevention policies proposed by national and international entities should be emphasized in order to reduce risk factors for dengue transmission, as the reduction of regular and potential breeding sites such as bottles, tires, clean water containers, flowerpots, vases with flowers and all possible places that serve as mosquito breeding sites. (*OPS, 2010*). Alternatives different from the traditional spraying strategies and educational messages, should be tested. Some based on biological control agents such as the crustacean Mesocyclops have been highly effective (*Lenhart, A, 2008*)

- It advisable to must also continue with the complete surveillance systems, maintain an adequate clinical monitoring, laboratory and entomological disease and vector, strengthen the management of outbreaks and epidemics with continuous training of health personnel, and involve other governmental and / or non-government and especially the community as a strong participant in dengue prevention and control actions. This is to reduce the incidence and case fatality rates of dengue. (*CCSS; 2009*)

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