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Seasonal Variations in Vector Borne Infections - Malaria and Dengue

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Malaria afflicts 36% of World's population i.e. 2020 million in 107 countries situated in tropical and subtropical region. Global incidence of dengue has grown dramatically in recent decade. About two fifth of World's population are at risk of infection and it is found in tropical and subtropical climate. It is estimated that 52% of World's population are at risk of contacting dengue infections. The aim of this study was to correlate the incidence of malaria and dengue with the rainfall in the Aligarh region. The diagnosis of dengue was made by serology (SD BIOLINE), and the diagnosis of malaria was made by Giemsa stained peripheral blood smear examination, Quantitative Buffy Coat examination and Rapid antigen detection test for malaria. Month wise rainfall record was plotted against the cases of dengue and malaria. Statistical analysis was done by SIGMA PLOT version 9. P value was found to be significant for the incidence of malaria and dengue cases to that of rainfall.

Key words: Malaria, Dengue, Rainfall.

There is increasing scientific interest in the potential effects on health of global change in climate. Temperature and humidity is the key feature for the timing of normal physiological processes, hence the growth and development of living organisms. One area that has received special attention is the association between climatic variation and vector borne diseases[1,2] . Dengue and malaria is the most important vector borne diseases in the World[3]. These diseases affect hundreds of millions of people every year. Both infections are transmitted by mosquito species, those are adapted to live near areas of human habitation. *Aedes aegypti* feeds during day and prefer human beings to other animals. No effective vaccine is yet available for both the diseases. Therefore, the control of disease is primarily based on vector control. This study was conducted during the months of rainfall and prevalence of dengue and malaria was evaluated in Aligarh, a city 140 Km South East to New Delhi India.

The vector borne diseases transmission is climate sensitive for many reasons. Mosquito requires water and optimum temperature to breed, for larval development and development of malarial parasite in case of malaria [4,5] and also if the temperature is too low viral development is slow and vectors are unlikely to survive long enough to become infectious. Dengue fever is an arboviral disease transmitted by mosquitoes in tropical and subtropical countries. It is caused by four closely related but antigenically distinct virus serotypes (DEN-1, DEN-2, DEN-3, DEN-4) of the genus flavivirus[6]. It is estimated that 52% of the global population are at the risk of contacting dengue fever living in South East Asia Region. In most of the tropical and subtropical countries dengue and malaria epidemics are reported to occur during the warm, humid and rainy season, which favours abundant mosquito growth and shorter extrinsic

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incubation period. [7-10]. Currently, more than 2.5 billion people live in high risk areas of dengue fever in the World [11]. Dengue fever has been known to be endemic in India for over two centuries as a benign and self-limited disease[12]. Recently the disease has changed its mode of manifestation in the severe form as dengue haemorrhagic fever[12]. During 2010 there were 28292 dengue cases and 110 deaths were documented in India and in the year 2011, 14047 dengue cases and 93 deaths were reported[13].

Malaria is one of the most important parasitic infection in people, accounting for an estimated 500 million clinical attacks worldwide and more than 1 million deaths per year, mostly in sub-Saharan Africa[14]. In India there were 1.49 million cases and 767 deaths due to malaria in the year 2010[13]. Malaria is associated with seasonally warm semi-arid areas where nearly 124 million people are considered at risk of climate-related malaria[15]. Most cases of malaria in India occur in Orissa. Orissa has a population of 36.7 million (3.5% of India), it contributes 25% of a total of 1.5-2.0 million reported malaria cases annually, 39.5% of *Plasmodium falciparum* malaria, and 30% of deaths caused by malaria in India. Uttar Pradesh (UP), India's largest state, contributes only 5% of total cases[16].

MATERIALS AND METHODS

The study was conducted in the department of Microbiology and Central laboratory Jawaharlal Nehru Medical College and hospital (JNMC), Aligarh Muslim University (AMU), Aligarh from January 2010 till December 2011. The climate is characterized by three distinct seasons, summer (April to June), Monsoon (July to October) and winter (November to March). The average temperature, rainfall and relative humidity during three seasons are as follows:

Summer: Temp 22^0-42^0C, Rainfall 0.1 – 71 mm and relative humidity 17-56 %.

Monsoon: Temp 18^0-39^0C, Rainfall 1 – 494 mm and relative humidity 34-83 %.

Winter: Temp 6^0-29^0C, Rainfall 0.3 – 123 mm and relative humidity 76 %.

The average annual temperature is 26^0 C & humidity 76%.

The study group comprised of all patients who presented with or without characteristic symptoms of malaria were screened for one of two most important causes of infections i.e. malaria and dengue using different diagnostic techniques. The diagnosis of malaria was made by, Peripheral blood smear examination stained by Giemsa stain, Quantitative Buffy Coat (QBC) and Rapid malaria antigen detection test (RDT). The diagnosis of dengue was made by using antigen & antibody detection kit (SD BIOLINE diagnostics). The diagnosis of dengue was made by detection of NS-1 antigen, detection of IgM and IgG in the serum of suspected patients (SD diagnostics).

Correlation between rainfall and prevalence of dengue and malaria were studied by determining geographical data and overall infection rate of both the diseases. The geographical data were transformed into rainfall distribution in India and presented as mm. The overall infection rates of dengue and malaria were transformed into prevalence and presented as percentages.

RESULTS AND DISCUSSION

Total number of specimens received for the dengue serology during the year 2010 were 1763, out of which 309 (17.52%) were positive for either IgM, IgG or NS-1 antigen (SD BIOLINE) and out of these 309 positive cases 268 (87.73%) were reported between July to October 2010 which is significantly higher than the other seasons. In the year 2011 specimens received for dengue serology were 1233, out of which 64 (5.19%) were positive and out of these 64, forty two (65.2%) cases were during monsoon season.

13735 blood specimens were received in malaria laboratory from January 2010 to December 2010 out which 1922 were positive for either of Plasmodium species i.e. 14% for malaria and out of these 1922 positive cases 1541 (80.17%) were diagnosed from July 2010 to October 2010 (Monsoon season). In the previous year (2011), total number of specimens received in malaria laboratory were 11,119 out of which 1246 (11.20%) were positive. And also out of these 1246 cases 981(78.73 %) were diagnosed between July to October 2011, which is significantly higher as compared to other months.

Fig 1 and Fig 2 is showing relationship between malaria and dengue in relation to rainfall respectively. Due to unavailability of rainfall

Table 1.

	coefficient	t value	P value	R^2	Adj R^2
Months	0.940	0.127	0.902	0.619	0.476
Malaria cases	0.538	3.052	0.016		
Dengue cases	-2.046	-3.325	0.010		

records of 2011, exact statistical relationship can not be commented. Statistical analysis was done by Sigma Plot version 9. As shown in the table-1 multiple linear regression of rainfall for prediction of incidence of malaria and dengue cases was evaluated. P value for the malaria and dengue cases was less than 0.05, and overall P value (Shapiro-Wilk test) was 0.007, which is also statistically significant.

Transmission of mosquito borne diseases is climate sensitive. Mosquitoes require stagnant water to breed and warm temperature for normal physiological functioning. If the weather is too cold mosquitoes are unlikely to survive long enough to become infectious.

This two year study in Aligarh region confirms that dengue and malaria transmission are strongly determined by rainfall. Although other factors such as vector population, source of infection, environmental temperature may also contribute to an epidemic to occur. This is an accordance to study conducted by Liang et al 2009 in Guangzhou a town in China[17].

Optimum temperature and humidity reduces the extrinsic incubation period (EIP) of the pathogen, increases the contact or biting rate of vectors that must feed more often to hatch[18] their eggs and also vectors digest blood meals more quickly at higher temperature, humidity[19]. Brukard JM et al (2008) studied the effect of temperature and precipitation on the re-emergence of dengue in Texas-Mexico border region and reported that incidence of dengue was increased by 2.6% one week after every 1^0C rise in weekly maximum temperature and increased by 1.9% two weeks after for every 1 cm increase in weekly precipitation[20]. Although Tian et al 2008 concluded that there is no significant relationship between rainfall and incidence of malaria in the Mangla County an area of tropical rain forest in South-West China, but they reported a significant relationship between malaria and fog[21]. Diaz et al also quantified the role of rain fall on the incidence of malaria in Mexico[22]. Johansson et al 2009 also strongly correlated the incidence of dengue with temperature and precipitation in Puerto Rico. Our study is also in strong accordance to these previous studies.

Rainfall and temperature are major detrimental factors in transmission of vector borne diseases like dengue and malaria. In addition to rainfall and temperature other environmental and host factors such as community interventions measures, human behaviours and degree of contact between human beings and vectors, all play an important role in spread of these infections.

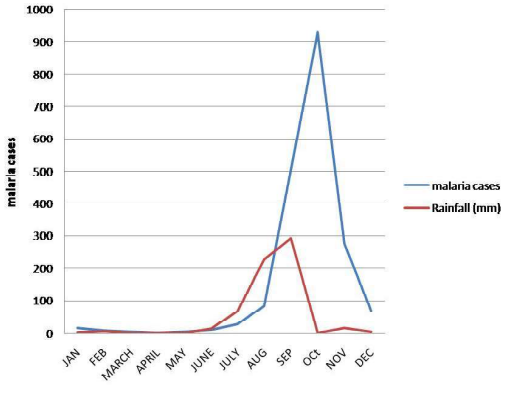

Fig. 1. Relationship between Rainfall and Malaria, 2010

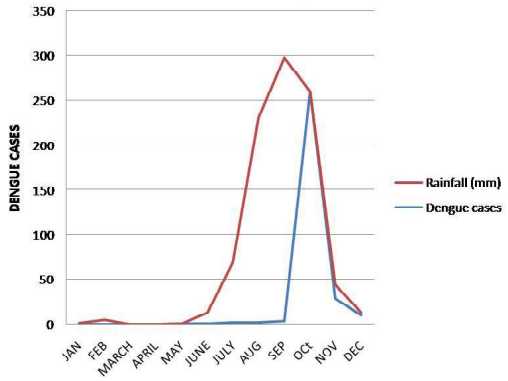

Fig. 2. Relationship between Rainfall and Denuge, 2010

Due to paucity of data regarding other environmental factors which play an important role in disease transmission, we have analysed only rainfall as a major seasonal variable in increasing the incidence of vector borne diseases. So any patient complaining of fever of unknown origin should be screened for dengue and malaria in this part of country.

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