Original Article

Predictors of Dengue Fever and Dengue Haemorrhagic Fever in Punjab, Pakistan

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ABSTRACT

Objective: This study was conducted to assess the future threat of Dengue Fever and Dengue Haemorrhagic Fever in Punjab, Pakistan

Study Design: Observational and Analytical Study**.**

Place and duration of Study: This study was conducted at Directorate General Health Services Punjab, Lahore and data was collected from 1st Jan 2008 to 31st Dec. 2008.

Materials and Methods: Primary data of laboratory confirmed cases was collected from all levels of health facilities of public and private sector. Disease vectors were collected from Lahore. Data of rainfall and temperature were obtained from website of department of meteorology Pakistan to determine the potential values.

Vector-borne diseases are the serious health problems worldwide, including Pakistan. Coverage of control interventions and physio-environmental factors were also analyzed.

Results: In 2008 there was a largest epidemic of dengue fever in Punjab and 1382 cases were reported in 16 districts out of 36, which increased in number of cases up to 5724 and district up to 34 in 2010. Our results suggest that rainfall and temperature were predictive of the abundance of Ae.aegypti and Ae.albopictus and in time interventions have positive significant impact on disease transmission.

Conclusion: This paper offered useful information that the climatic and physio-environmental factors like built-up, agriculture, water bodies and forest areas have different influence on the dengue fever incidences. This will help in focusing the preventive measures being applied on priority in very high and high-risk zones and save time and money. No special funds were used for this study.

Key words: Ae.aegypti, Ae.albopictus, precipitation, temperature, prediction, physio-environment..

INTRODUCTION

Vector borne diseases are the most common worldwide health hazard. Among these, dengue fever is especially wide spread in tropical and arid zones. It is transmitted to the man by the mosquito of the genus Aedes and exists in two forms: the Dengue Fever (DF) or classic dengue and the Dengue Haemorrhagic Fever (DHF), which may evolve into Dengue Shock Syndrome (DSS) (1). Dengue infection occurs due to the bite of the mosquito Aedes aegypti (Ae.aegypti) or Ae.albopictus that is infected with one of the four dengue virus serotypes (2). The infection, earlier restricted to urban/semi-urban centres, now can be seen in rural areas as well. Land use/land cover types and climate, play significant role in dengue cases as reported by several researchers (3). Recently Geographic Information Systems (GIS) and remotely sensed data are being used to evaluate and model the relationships between climatic and environmental factors with the incidences of viral diseases. Spatial analysis involves the use of Geographic Information Systems (GIS) for health; both spatial and temporal changes in environmental condition may be important determinants of vector-borne disease transmission (4-9). Remote sensing data can be used to provide information on the spatial distribution of the vector-borne diseases and the physical environment (10-12). It is mentioned by a researcher that remote sensing and geodesy have the potential to revolutionize the discipline of epidemiology and its application in human health (13). A temporal analysis of Landsat Thematic Mapper (TM) satellite data was employed to predict and map the location of some of the major diseases affecting human health as well (14). Land use/land cover types are the critical variables in epidemiology and can be characterized by remote sensing (15). 1382 dengue fever cases were reported in 2008 in Punjab, Pakistan (16). In present study predictors like environmental factors and vector density has been evaluated and tried to find out the correlation between vector and environment. The objective of the study was to assess the expected future magnitude of diseases incidence in the light of various factors and availability of disease vector density. Assumption of prediction was made on the basis of same type of conditions in other countries where dengue epidemics occurred that concerned may make necessary arrangements to avert the situation.

MATERIALS AND METHODS

Punjab province consists of 36 Districts, located in the eastern border of Pakistan, was selected as the study area (Figure-1), people are pre-dominantly involved in the agriculture.

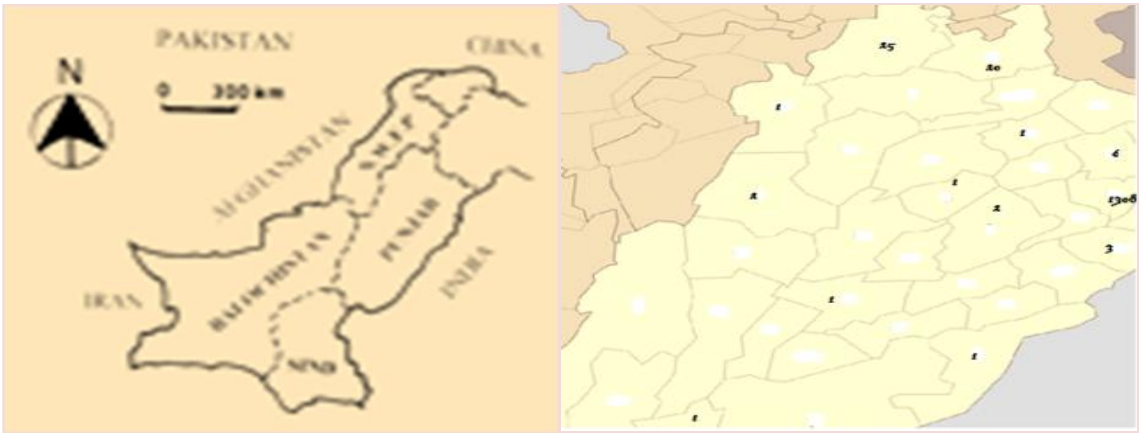

Figure-1: Showing geographical distribution of Dengue Fever cases in different districts of Punjab, Pakistan

Population is about 73,621,000(1998) and area is 205,345 km² with Density people/km² 358.52 (17). Climate of this area is subtropical with extreme high temperatures rising to 46°C in May and dipping low up to 13.2°C in December. In 2008, the average annual temperature of Lahore was 32°C. The weather of Lahore is extreme during the months of May, June and July, when the temperatures soar to 40–48 °C (104–118 °F). The monsoon seasons starts in mid July and continues till mid September, with heavy rainfall throughout the province. The highest temperature was 48.3°C (118.9 °F) recorded in Lahore on May 30, 1944 (18), lowest recorded in was −1.1°C (30.0 °F) on 13 January 1967 (19), the highest rainfall recorded during 24 hours is 221 millimeters (8.7 in) on 13 August 2008 (20), and total 917 millimeters (36.1 in) rain was recorded (21), which influenced dengue transmission in addition to the temperature, and humidity (22). Due to high humidity during rainy season mosquito survival became longer and growth was facilitated (23). Retrospective study was designed and primary medical data from 1st January 2008 to 31st December 2008 was collected from the Provincial Health Directorate Punjab which was collected during epidemics on daily basis.

Regression analysis was used to explore the relationship between the monthly climatic parameters and the number of incidences of DF/DHF in Punjab province. Multiple regression analysis is employed to predict the dengue incidences. The independent variables were used to predict changes in the dependent variable in the rainy and non-rainy seasons. Number of peoples affected by DF/DHF was used as the dependent variable and the rainfall(R), temperature (T) and relative humidity (H) were considered as the independent variables. Multiple regression analysis was carried out for each of the observations of the occurrence of DF/DHF cases and monthly climatic data of 5 years (2006-2010).

RESULTS

In 2008, 1382 DF/DHF cases were reported in Punjab. District wise cases are given in Table 1. Morbidity rate was observed at 1.88 per 100,000 people. The DHF incidences were recorded at the village level by recording complete address. Highest numbers (1308) of dengue incidence were recorded in districts Lahore.

It was found that highest number of cases occurred during November and December (Figure-2). This figure indicated the seasonal dependence of DF/DHF cases, which shows high incidence after rainy season.

The rainfall data of said years were collected from the website of Meteorology Department Government of Pakistan (25) and is given in figure-3 along with number of DF cases. Higher than 20°C is the favorable temperature for Aedes aegypti mosquitoes (2), the average relative humidity observed in 5 years (2006-2010) were 95.6 percent. The 30 years (1961–1990) average monthly rainfall was 24.75 inches in Punjab (24).

The seasons of Punjab are divided in two types in broader context: rainy and non rainy; hence, the effect of these three factors on dengue was analyzed for these two parts of the year. The analysis revealed the land use areas as: agricultural (74.7%), forest (21%), water bodies (0.3%) and Built-up (4.0%) for the year 1998 (24).

Dependence of the climatic variables was evaluated using multiple regression analysis. In addition, as suggested by many researchers, physio-environmental factors also affect the dengue fever incidence, vector density and control activities (Figure-4). Information value approach was utilized to explore which physical and environmental factors are more crucial in dengue incidences and found highly significant (p=0.000) correlation between vector density and diseases but significant (p=0.04) correlation between rain and vector density.

Table No. 1: Monthly distribution of DF/DHF cases in Punjab province in 2008

Sr.#	Districts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	Attock										12	13		**25**
2	B.Nagar											1		**1**
3	Bahawalpur													
4	Bhakkar										1	1		**2**
5	Chakwal													
6	D.G. Khan													
7	Faisalabad										1	1		**2**
8	Gujranwala										1			**1**
9	Gujrat													
10	Hafizabad										1			**1**
11	Jhang													
12	Jhelum													
13	Kasur											2	1	**3**
14	Khanewal													
15	Khushab													
16	Lahore.	30	43	103	46	28	29	29	29	28	59	312	570	**1308**
17	Layyah													
18	Lodhran													
19	M.B.Din													
20	Mianwali											1		**1**
21	Multan											1		**1**
22	Muzaffargarh													
23	Nankana Sb													
24	Norrowal										2	3	1	**6**
25	Okara													
26	Pakpattan													
27	R.Y.Khan											1		**1**
28	Rajanpur													
29	Rawalpindi			5	3						6	5	1	**20**
30	Sahiwal													
31	Sargodha												1	**1**
32	Sheikhupura										1	2		**3**
33	Sialkot													
34	T.T. Singh													
35	Vehari										2	4		**6**
36	Chaniot													
	Punjab	**32**	**45**	**109**	**49**	**30**	**31**	**31**	**31**	**30**	**62**	**330**	**602**	**1382**

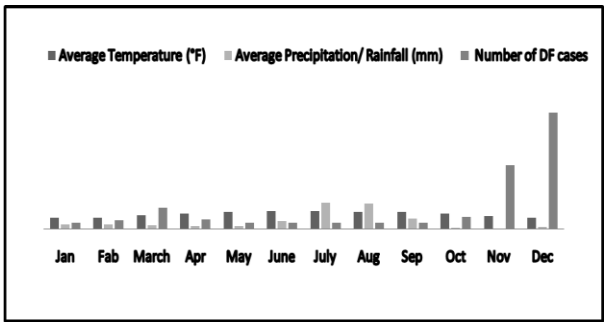

Figure-2: Showing month wise average temperature, rainfall and number of cases in Punjab, Pakistan.

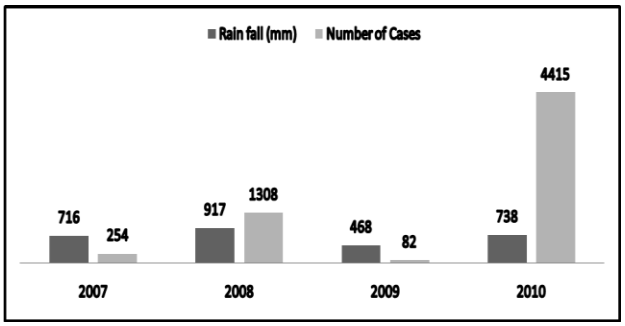

Figure-3: Showing year wise rainfall and dengue fever cases in Punjab, Pakistan

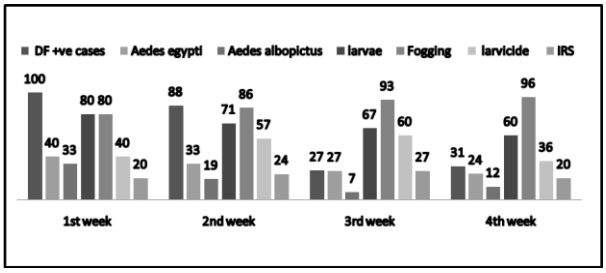

Figure-4: Showing week wise correlation between dengue fever cases, vector density and control activities in Punjab, Pakistan.

DISCUSSION

As reported that the dengue fever was earlier restricted to urban/semi-urban centres, but now can be seen in rural areas as well (3). The same has been observed by the analysis of data during 2008 and 72 cases out of 1382 cases were reported from rural areas. Land use/land cover types and climate, play significant role in dengue cases as reported by several researchers (3), same observation has been made by author in Punjab that from agricultural areas upper Punjab more cases have been noted.

By the time a person infected with dengue virus develops fever the infection is widely disseminated to many people. The virus is found in serum or plasma, in circulating blood cells and in selected tissues, especially those of the immune system, for approximately 2-7 days, roughly corresponding to the period of fever (2). According to the development period from egg to human disease, there is a time lag of about one month that leads to DF/DHF cases occurring during 7-45 days. The duration of larvae stages to adult is 7-12 days and the lifespan of for female mosquito is about 8 to 15 days, meantime the virus develops in the mosquito for a period of 8–10 days (23). The monthly number of cases reported in Punjab showed the same pattern and maximum cases have been reported in November and December 2008, despite the decrease of temperature due to time lag pattern. Thus, DF/DHF cases at time *t* (in month i.e. May) depends on others factors at time *t-1* (one month before *t* i.e. *t-1* or the month April). In this empirical relation, the regression coefficients represent the independent contributions of each variable to the prediction of the dependent variable.

CONCLUSION

This paper has offered some useful information related to the dengue incidence. Analysis of the climatic factors such as rainfall, temperature and humidity with the dengue incidences has revealed that dengue generally occurred when average temperature rose above normal. It also occurred when the rain-fall was comparatively lower and humidity was higher than average. An analysis of physio-environmental factors such as land use/ land cover types with dengue incidence was carried out. The aim of this analysis was not only to find the effect of physio-environmental factors on dengue incidences but also to find influence of these factors in quantitative terms. It was found that built-up areas have highest influence and constitute the highest risk zones. The agriculture areas offered the second level of high-risk influence. Water bodies posed also significant risk. Forest areas almost do not have any influence on the dengue risk zonation. This will help in focusing the preventive measures being applied on priority in very high and high-risk zones and save time and money.

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