SPATIAL AND SEASONAL VARIATION OF DENGUE FEVER IN LAHORE 2008

ZARFISHAN TAHIR, SALMA HAFEEZ AND ASLAM CHAUDHRY

Bacteriologist Laboratory, Institute of Public Health, Lahore

ABSTRACT

Objectives: 1. To find out the spatial and demographic profile of cases of dengue fever outbreak in Lahore (2008). 2. To find out the seasonal variation of the dengue fever outbreak.

Study Period: Jan 2008 to Dec 2008.

Study Design: Retrospective cross-sectional study.

Setting: Bacteriologist laboratory at Institute of Public Health Lahore.

Sample Size: All the cases reported from Lahore city to the Bacteriologist laboratory during the study period.

Methodology: Blood samples from 3215 dengue suspected cases referred to Bacteriologist laboratory from different areas of Lahore were tested for IgM antibodies by ELISA after subjecting them to initial screening by rapid immunochromatographic technique (ICT). Demographic and residential data was recorded.

Results and Conclusions: Among 3215 dengue suspected cases, 1766 (54.94%) were found serologically reactive for IgM antibody. Reactive cases were stratified spatially according to administrative towns of Lahore. Higher positivity of dengue cases was observed in densely populated areas of the Lahore. Maximum reactive cases (73.21%) were observed during month of November. Patients in age group 20 – 29 years were more frequently affected (32.33%). Only 74 cases (4.1%) were children below 9 years. Males (58.55%) were affected more commonly than females (41.44%). It is concluded that during epidemic of dengue fever in Lahore (2008), more cases were observed from September to December from densely populated areas of Lahore in age group 20-29 years. Protective measures should be adopted for at risk population. Our study forms the basis for public health measures for better control of vector.

Key words: Dengue fever, Outbreak, Lahore.

Introduction

Dengue fever (DF) and dengue hemorrhagic fever (DHF) are acute febrile illnesses caused by four closely related virus serotypes of genus *Flavivirus*. It is also known as break bone fever.[1] Dengue is transmitted to humans by the bite of Aedes aegypti or more rarely by Aedes albopictus mosquito.[2] The global prevalence of dengue fever spectrum has grown dramatically during the recent decades. Every year about 50 – 100 million cases of dengue infection, 500,000 cases of DHF and at least 12,000 deaths due to this disease occur worldwide.[3] In 1970 only 9 countries had known epidemics of dengue hemorrhagic fever. This number increased by more than four – fold in 1995 and about 2500 million people are now exposed to the risk of Dengue fever.[3] Dengue is now endemic in more than 100 countries.[4] During the past decade, DF epidemics have occurred in most of the south east Asian countries including Pakistan.[5-7]

In Pakistan, an outbreak of DF was first reported in Karachi in 1994.[8,9] A recent outbreak of DF in Karachi occurred in 2005 where Aga Khan University reported 42 positive cases out of 106.[10] In 2006 outbreak in Karachi, case fatality rate for DHF / DSS group was 4.6%.[11] Since then dengue cases are reported every year from Karachi.[12] Dengue cases were also reported in upper parts of Punjab in 2003, in addition to sporadic cases in Rawalpindi, Mangla, Peshawar, Abbottabad and Haripur.[13] Dengue cases were also reported from Lahore city in 2006 and 2007.[14,15] However in 2008, an epidemic of dengue fever hit Punjab province mainly the Lahore city.[16]

Previous studies from Pakistan elaborated clinical and haematological features of Dengue fever cases, with particular emphasis on haemorrhagic manifestations. The present study looks into the spatial, demographic and seasonal aspects of the disease spread. Epidemiologic tracking of DF cases by age, season and geographic setting was carried out
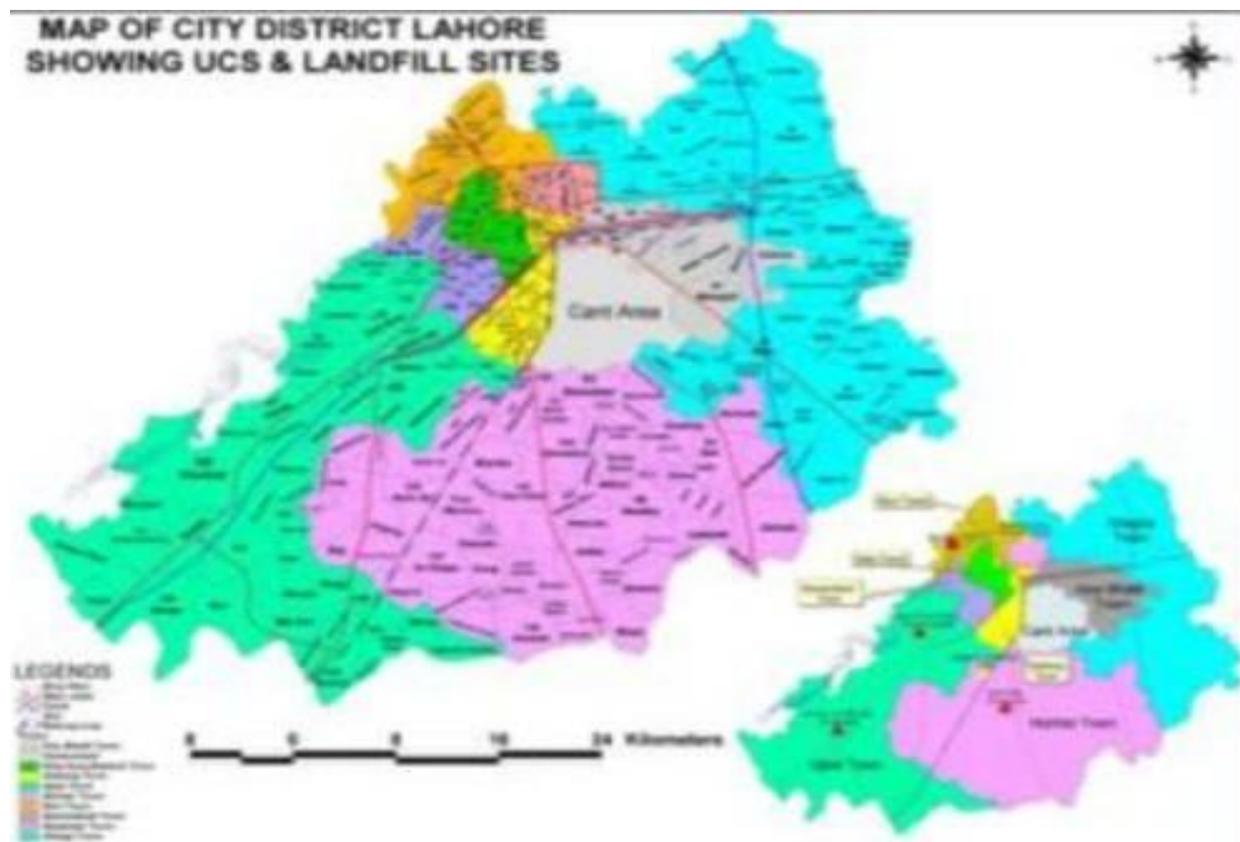
so as to understand various dynamics of disease for devising effective control strategies.

MATERIALS AND METHODS
Geography and Population of Lahore
Lahore, being the second largest city of Pakistan is the capital of province of Punjab. The city lies between 31° 15´ and 31° 45´ North latitude and 74° 01´ and 74° 39´ East. River Ravi is the only river in the city that flows along the northern side of Lahore. The city covers a total land area of 404 km², but is still expanding at a considerable rate. According to the 1998 census, the total population of Lahore district was approximately 6.8 million. Mid 2006 government estimates now put the population at approximately 10 million and the population density has grown to 5,770 / km².[17]

City – district of Lahore is divided into nine administrative towns and a separate military cantonment. Each town in turn consists of a group of union councils (U.C) for smooth execution of administrative work.[18,19] These towns are Samanabad, Data Ganj Baksh, Allama Iqbal, Gulberg, Nishtar, Shalimar, Ravi, Aziz Bhatti and Wagah. There is a local district government administrative system of Executive District Officers, Districts officers, Nazims and Naib Nazims[19] Area and population of different towns is not uniform (See Lahore map). Population ranges from 647181 to 1109262 with an average of 881988.[20]

Diagnosis of Dengue Fever in Lahore
Currently, the laboratory of Bacteriologist at Institute of Public Health Lahore is the major laboratory dealing with the diagnosis of Dengue fever cases in Punjab province. At present, only passive surveillance of the dengue cases is being carried out for the last three years.

The laboratory is under administrative control of Director General Health Punjab. It also deals with diagnosis of epidemics and emerging and re-emerging diseases from all over Punjab province.

Patient Population
During 2008, clinically suspected cases of dengue fever were referred to the Bacteriologist Laboratory at the Institute of Public Health for confirmation of disease. Cases reported from 1.1.08 to 31.12.08 were included in study. They drained from all over Lahore city. Specific inclusion criteria defined cases presenting with fever above 100°F of more than five days duration at the time of blood sample collection.

Data regarding patient's age, sex, and complete residential address was collected. Five ml of venous blood sample was collected aseptically from suspected patients and sera separated for serological
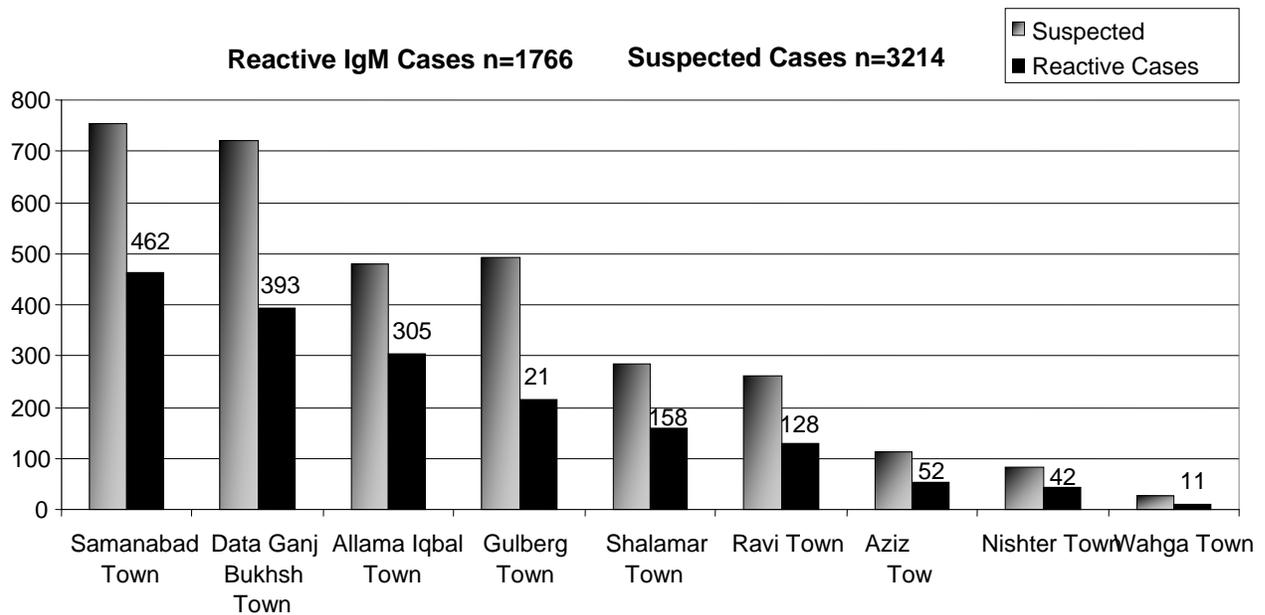
Fig. 1: *Distribution of cases of Dengue Fever in Towns of Lahore (2008).*

diagnosis of current dengue infection. Screening for IgM antibody was done by immunochromatographic technique. Serum samples were confirmed with IgM – capture ELISA (Diagnostic Automation USA) for dengue virus.

RESULTS

A total of 3214 patients clinically suspected of dengue fever from different areas of Lahore visiting Public Health Laboratory between 1.1. 2008 to 31.12.2008 were tested for dengue infection. Out of these 1766 (54.94%) were confirmed serologically reactive for IgM antibody reflecting recent dengue infection.

Fig. 2: *Month wise distribution of cases of dengue fever in Lahore (2008).*

Out of nine administra-tive towns of Lahore, maxi-mum dengue cases (61.19%) were diagnosed from Samanabad town. Samanabad town comprises of 19 union councils. Out of 755 clinically suspected cases from this town, 462 (61.19%) were found reactive. The confirmed cases were reported from 12 union councils. Maximum number of reactive cases belonged to U.C Samanabad (122), Ichra (116) and Gulshan Ravi (90).

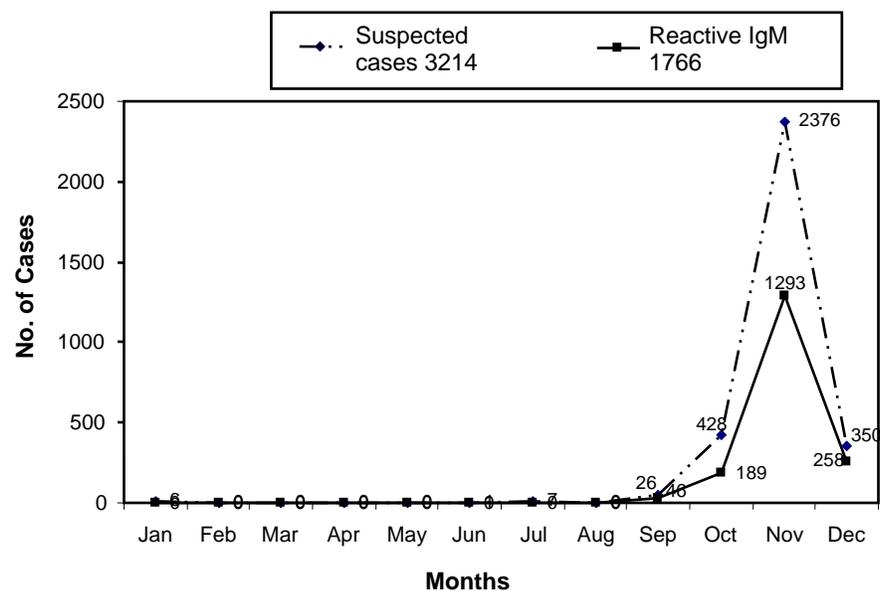Data Ganj Baksh town followed Samanabad to-

wn. Amongst 18 U.Cs, reactive cases were reported from 14 U.Cs. Out of 720 clinically suspected cases from this town, 393 (54.58%) were confirmed serologically. Maximum number of reactive cases was reported from U.C Race Course (65), Mozang (62) and Sanda Kalan (52).

Third town with highest number (305) of confirmed reactive cases was Allama Iqbal town. Out of 19 U.Cs, reactive cases were reported from 8 U.Cs. Dhanwal and Bakar Mandi were the highly affected

U.Cs with 119 and 107 cases respectively.

Gulberg town followed the Allama Iqbal town with a total of 215 confirmed cases. Maximum number (125) belonged to U.C Kot Lakhpat. Gulberg Town was followed by Shalimar Town, Ravi Town, Aziz Bhatti Town, Nishtar Town and Wagha town with 158, 128, 52, 42 and 11confirmed cases respectively

Reactive dengue cases were reported from every town of Lahore with varying number of union councils involved in each town (Table 1).

The overall attack rate in Lahore city was 0.0222 and was not uniform for all towns. Highest attack rate was observed in Samanabad town and lowest in Wagah town.

All positive cases were observed between September and December with a peak in the month of November, indicating a seasonal trend of the outbreak. Twenty six cases were observed during September, 189 in October, 1293 in November and 258 in December 2008.

The involvement of all age groups was seen, especially the adults. The mean age of the dengue patients was 29.79 ± 14.99 years and 32.33% belonged to 20 – 29 age group. Males were affected more (58.55%) as compared to females (41.44%).

DISCUSSION

Number of cases of dengue fever are continuously being reported from Lahore city during recent years. In year 2006, 309 seropositive clinical cases of dengue fever were recorded, whereas in 2007, 107 cases were detected in the Laboratory of Bacteriologist Lahore. In year 2008, a major epidemic hit Lahore city with number of cases reaching 1766. Present study attempts to highlight the major areas of Lahore city affected by dengue epidemic in 2008.

Cases of DF were reported from all towns regularly. However, number of reactive cases and their varied distribution in each town indicateds that certain areas were more affected than others.

Based upon geographical distribution, dengue cases were mainly concentrated in towns which were densely populated. Towns with high burden of disease (Samanabad, Data Ganj Baksh) have smaller areas and dense population. Population of these towns was 949558 and 1109262 respectively as reported in January 2009.[20] Dense population in different towns of Lahore can be correlated to increased urbanization of this city. Pakistan like other developing countries in the region has witnessed accelerated process of urbanization. A significant number of people also settled in Lahore from other areas of Punjab. This phenomenon alone resulted in two to three folds rise in population of this city in short span of time.[21] Overcrowded living conditions predispose increased number of susceptible hosts to the bite of Aedes aegypti (urban specie) which is a restless mosquito and bites several people in a short period for one blood meal.[22,23] Population growth also over taxes the water, sewer and waste management systems, creating ideal conditions for mosquito-, rodent- and water borne infections.[24] Inade-

Table 1: *Proportion of affected Union Councils in towns of Lahore city.*

Towns	Total no. of Union Councils	Union Councils with reactive Cases	% age affected area
Samanabad	19	12	63.15
Data Ganj Baksh	18	14	77.78
Allama Iqbal	19	8	42.11
Gulberg	15	10	66.67
Shalimar	17	10	58.82
Ravi	19	7	36.84
Aziz Bhatti	13	7	53.84
Nishtar	18	3	16.67
Wagah	12	4	33.33

Table 2: *Attack rate of dengue cases in different towns of Lahore.*

Towns	Population at risk	No. of cases (% age)	Attack rate
Samanabad	949558	462 (26.16)	0.0486
Data ganj Bakhsh	1109262	393 (22.25)	0.0354
Allama Iqbal	1037692	305 (17.27)	0.0293
Gulberg	667108	215 (12.17)	0.0322
Shalamar	862435	158 (8.94)	0.0183
Ravi	996708	128 (7.24)	0.0128
Aziz Bhatti	719566	52 (2.94)	0.0072
Nishtar	948382	42 (2.37)	0.0044
Wagah	647181	11 (0.62)	0.0016
Total	79,37,892	1766 (99.96)	0.0222

quate water utilities lead to situations when residents have to store water in jars and tanks for their daily needs which are not usually emptied regularly. This becomes an ideal situation for Aedes mosquito breeding.[22] There is also lack of public awareness to respond to eliminate mosquito breeding sites especially indoor water storage bodies. In addition to increase in demographic density, mass production of non-biodegradable plastic containers that are discarded in environment and used automobile tires are important sites of mosquito breeding.[25-27] An entomological survey report of Lahore 2009 revealed that maximum larval and vector density of Aedes mosquito was found in the old tire markets of Data Ganj Baksh and Samanabad Town.[28] This strongly correlates with the finding of maximum number of reactive cases recovered from these towns.

Proximity to River Ravi was also found to be a predisposing factor for increased number of cases. Although Iqbal town is one of the biggest town area wise, yet it ranks third in terms of burden of dengue fever cases. On further scrutinizing the geographical distribution within Allama Iqbal town, it was found that most of the positive cases of this town are concentrated in two union councils which are located closest to River Ravi. Peri – urban UC of Samanabad Town (Gulshan Ravi Band road, Bakar Mandi Band road) with increase number of reactive case are also in close proximity to River Ravi. Following monsoon season there is increase in water discharge in the river and its surrounding land filled sites are often converted into water pools. Such flood plains can be prolific sources of Aedes aegypt resulting in increased number of dengue cases from nearby areas.[29]

The proportion of union councils with reactive cases in different towns showed that more than half to three fourth area was involved by the epidemic in most of the densely populated towns. Besides dense population, increased mobility of people within and between the towns is amongst the significant factors facilitating the circulation of the agents and vectors of transmissible diseases.[30]

The attack rate of disease refers to the number of new cases of specific disease per population at risk expressed as percentage. It is a specific incidence rate over a limited time interval.[31] In the present study, the overall attack rate of dengue cases in Lahore city was 0.0222. This may not reflect actual figure because many cases of dengue fever may also have reported to public sector hospitals and private laboratories. However, during epidemics of dengue fever, attack rates among susceptible population

Table 3: *Age and sex distribution of dengue patients.*

Age Groups	Male	Female	Total (%)
0 – 9	41	33	74 (4.1)
10 – 19	216	152	368 (20.83)
20 – 29	342	229	571 (32.33)
30 – 39	210	180	390 (20.08)
40 – 49	121	85	206 (11.66)
50 – 80	104	53	157 (8.89)
Total	1034	732	1766
Mean age ± S.D.	30.1 ± 15.45	29.3 ± 14.36	29.79 ± 14.99

were reported as high as 40-50%.[32]

Cases of dengue fever were observed following monsoon season between September to December with a peak in November. The weather of Lahore is extremely hot during the months of May, June, and July when the temperature soars to 40 – 46°C. Following the end of July the monsoon starts with heavy rainfall throughout the city and the province.[17] During August 2008, more rainfall was recorded as compared to previous years.[33] Transmission of dengue fever is often highly seasonal. In general, rainfall and increased humidity are major determinants of transmission due to increased breeding of mosquitoes.[34] Similar observation was seen in the year 1997 following 1996 epidemic in India.[35] These findings indicate that dengue infections are mostly seen in post monsoon season, hence preventive measures should be in full swing at the very onset of monsoon.

Age wise distribution of seropositive cases showed involvement of all age groups with significant number in young adults (20 – 29 years). This finding is consistent with other countries in south Asia.[36,37] In the present study the less common involvement of children below 9 years can be attributed to poor case detection due to non specific febrile illness.[24] We might have also missed these cases because of either reporting in hospitals or staying back at home. However, in certain endemic countries in Asia, young children were found major victims of dengue infection.[38]

In the present study male were predominantly affected in all age groups. Probable reason can be difference in the dress of two genders. Females of Punjab Pakistan are almost fully covered whereas males are exposed especially during hot weathers. Another explanation could be gender bias and male preferences in health care seeking, prevalent in

Asian and traditional societies.[39] Sex preponderance was not observed in some studies.[40-41]

Our study concluded that highlights the spatial, demographic and seasonal distribution of dengue fever cases observed during the epidemic in Lahore (2008). This has implications of finding of more fatal cases of DHF and DSS in successive years. Therefore, preventive measures should be in full swing in the pre-epidemic season. Campaigns for public awareness regarding personal protection and vector control should be launched timely. Small scale epidemiologic data with analysis should be integrated in local control programmes of vector transmitted diseases.

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