Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 5, Issue, , 11, pp.2024-2027, November, 2014

International Journal of Recent Scientific Research

RESEARCH ARTICLE

EPIDEMIOLOGICALAND ENTOMOLOGICAL INVESTIGATION DURING AN OUTBREAK OF DENGUE FEVER IN PUDUCHERRY, SOUTH INDIA

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ARTICLE INFO

Article History:

Received 5th, October, 2014
Received in revised form 12th, October, 2014
Accepted 6th, November, 2014
Published online 28th, November, 2014

Key words:

Dengue fever, *Aedes aegypti and Aedes albopictus*, Outbreak, Puducherry

ABSTRACT

Dengue is a worldwide public health problem spread throughout the tropical and subtropical zones. It is endemic in south-east Asia, the Pacific, East and West Africa, the Caribbean and the Americas. Dengue fever (DF) and dengue haemorrhagic fever (DHF) are emerging major public health problems in India. This longitudinal study was conducted during September to December 2013 in Puducherry to analyse epidemiological pattern of dengue outbreak in the district. Weekly trends of all cases reported indifferent hospitals from the first week of September to last week of December were monitored.Out of the 763 blood samples collected from suspected dengue cases (as per the WHO criteria), 641 were serologically confirmed, 523 were found positive for NS1 Ag and 118 for anti-dengue antibodies (either for IgM/IgG or both). Simultaneously immature surveys were conducted in different areas of the district and larval indices were calculated. The Surveillance data was usedto monitor the trend of the outbreak in terms of time, person and place. The rural to urban ratio of cases was found to be 1:2. Maximum number of cases (98) were reported from Lawspet PHC in urban area, and 39 from Villianur PHC among the rural areas. Mostcases of dengue fever were observed during the month of October. Males were affected more as compared to females in the ratio of 1:0.8. Majority of the cases (52%) belonged to the age group 15-34.The entomological indices House Index (HI), Container Index (HI)and the Breteau Index (BI)in rual and urban areas were found to be 30.0%, 33.2%, 54.6 % and 33.3, 38.2 and 65 respectively.

INTRODUCTION

Dengue is a worldwide public health problem spread throughout the tropical and subtropical zones. It is endemic in south-east Asia, the Pacific, East and West Africa, the Caribbean and the Americas. Dengue fever (DF) and dengue haemorrhagic fever (DHF) are emerging major public health problems in India and are reported from more than 19 states (Sharma *et al*, 2000; Kumar *et al*, 2008).The burden of dengue currently falls most heavily on Southeast Asia, but dengue has spread throughout Latin America and more than half of the world'spopulation now lives in dengue-endemic countries (WHO, 2011).Dengue, places 2.5 billion people in more than 100 countries at risk causing an estimated 50 to 100 million cases of dengue infections worldwide annually and thousands of deaths (Gubler, 2005).The dengue epidemics have become major public health problems and have the national important for the recent years.In India, the first outbreak of dengue fever was recorded in 1812(Jatanasen and Thongcharoen, 1993). From 1991 onwards the epidemics of dengue has been steadily increased to become very serious threat to public health in India. Now, India has become host for all the four types of dengue virus.The disease is transmitted by the *Aedes* genus (*Aedesaegypti*or*Ae. Albopictus)*mosquito vectors. The dengue epidemics were reported from 24 states / union territories of India with 37070 cases and 227 deaths during 2012 and it was steadily increased to become very serious threat to the public (NVBDCP,2013).

In spite of the preventive measures taken by the respective governments since then, recurrent outbreaks have been reported in most of the states of the country. Puducherry had reported first dengue outbreak in 2003 and since then regular outbreaks have been reported with major outbreaks in 2011(463 cases) and 2012(3506 cases) (NVBDCP, 2013). There is no specific treatment for dengue, however, with frequent and appropriate medical care; the lives of patients with the more serious dengue haemorrhagic fever (DHF) could be saved. The only way to prevent the transmission of dengue virus is to combat the carrier, *Aedes* mosquito (WHO, 1999].

Historically, DF/DHF has been reported as occurring predominantly among urban populations where density of dwellings and short flying distance of the vector create the right conditions for transmission.

Given the epidemic potential of dengue virus in Puducherry, adequate monitoring including early detection of cases, timely

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investigation and sustained mosquito control actions remain essential.

MATERIALS AND METHODS

Study area

Puducherry is a coastal town situated in the eastern peninsular India between 11′.46° to12′.15° latitude North and 79′.36° to 79′.53° longitude East. The population of the Puducherry area is about of 9, 46,600 covering an area of 293 sq. Kms. Puducherry experiences hot and humid climate except during January & February months which are comparatively colder. The temperature normally varies between 26°C and 38°C but the temperature never falls below 20°C. An outbreak of dengue was reported during September to December 2013 and a total of 641 clinically confirmed dengue fever cases were reported in different hospitals. The clinically suspected dengue cases started reporting from the month of September 2013, which coincided with the rains which usually commence during this month and last for about 4 months in this part of the country.

Collection of Blood samples

A network of passive survey, constituting local government and private hospitals and also private clinics, was established for receiving the blood samples from clinically suspected dengue cases identified as per WHO classification. A total of 763 samples were received from Puducherry and nearby villages under Puducherry district. Blood samples were collected 3–7 days post-onset of fever. The serum obtained from the blood samples was subjected to various investigations or stored at –70 °C till used.

Serological testing of blood samples

The samples were screened for the presence of dengue-specific IgM antibodies by IgM antibody capture enzyme-linked immune-sorbent assay (MAC-ELISA): using a kit prepared by the National Institute of Virology, Pune, India (as an integral part of the National Vector Borne Disease Control Programme), strictly following the manufacturer's protocol. For detection of the presence of dengue NS1 antigen in the acute sera, Pan Bio (Australia) NS1 ELISA kit was used.

Entomological Surveillance

A door-to-door survey was carried out in houses and peri-domestic areas of all 31 Primary Health Centres of Puducherry district to detect *Aedes*immature breeding with a view to study the prevalence, distribution, stratification of areas for *Aedes* mosquitoes and to identify high risk areas in the town prone to dengue/DHF outbreak. The larval collections were made simultaneously in each locality following the single larval technique of WHO to find out the *Aedes*breeding in all the wet containers present in and around the houses and their premises in the study areas. All kinds of breeding habitats in the study area like cemented tubs/tanks, overhead tanks, iron/metal drums, junk material, desert coolers, discarded tyres and curing tanks, etc. were screened with the help of flash-light and pipette, while bigger containers were searched with the help of a dipper of 300 ml capacity (having white background for better visibility). The type of breeding habitats and their locations were recorded. The data on larval survey were analysed and calculated in terms of different indices like container index (CI), house index (HI), breteau index (BI) as per the WHO procedure (WHO-SEARO., 2011).

$$\text{House Index (HI)} = \frac{\text{Number of positive houses}}{\text{Total number of houses surveyed}} \times 100$$

$$\text{Container Index (CI)} = \frac{\text{Number of positive containers}}{\text{Total number of wet containers}} \times 100$$

$$\text{Breteau Index (BI} = \frac{\text{Number of positive containers}}{\text{Total number of houses surveyed}} \times 100$$

RESULTS

Epidemiological findings

Serological outcome

Out of the 763 blood samples collected from suspected dengue cases, 641 were serologically confirmed (as per the WHOcriteria), 523 were found positive for NS1 Ag and 118 were positive for anti-dengue antibodies (either for IgM/IgG or both).These results indicated the occurrence of current (primary) as well as secondary infections in Puducherry(Table 1).

Table 1 Serology of the dengue fever cases reported during the outbreak

DF cases positive for NS1	523	81.6 %
DF cases positive for IgG, and/or IgM	118	18.4 %
Total Number of Dengue fever cases	641	

Prevalence of disease was more common in urban setting than the rural ones and most of the cases were reported in Villianur PHC (39) in rural and Lawspet PHC (98) among urban areas (Fig. 1). Fever cases started to appear in the first week of September, attained peak in October (157 cases in Urban & 57 cases in Rural area) and thereafter showed a decline in November and December (Fig. 2). Males (347) were affected more as compared to females (294) shown in fig. 3.

Fig. 1 Map showing PHC- wise distribution of dengue confirmed cases in Puducherry during outbreak-2013

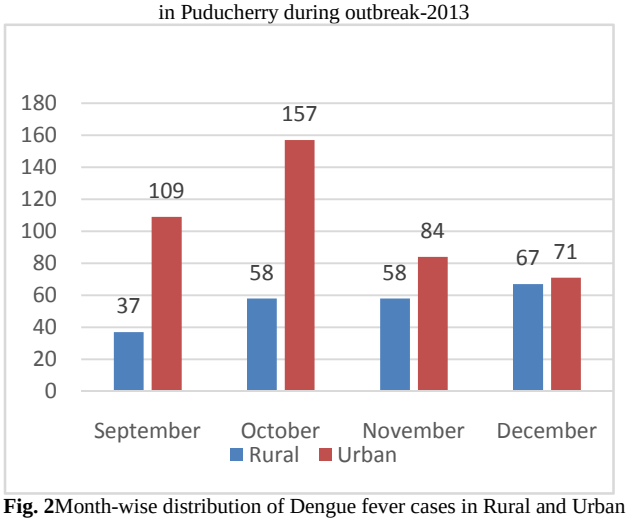

Fig. 2 Month-wise distribution of Dengue fever cases in Rural and Urban areas of Puducherry during outbreak-2013

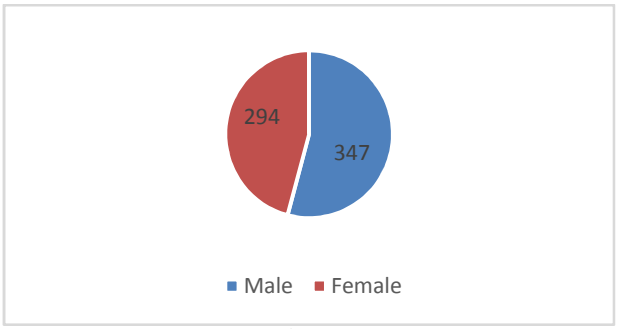

Fig. 3 Sex-wise distribution of Dengue patients in Puducherry-2013

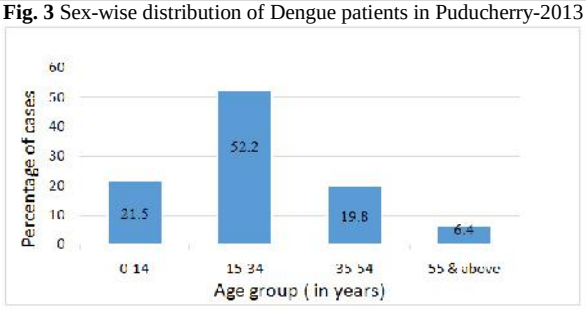

Fig. 4 Incidence per age distribution of the dengue cases

Case distribution by age

The age distribution of the DF cases shows the highest incidence over 15 to 34 years old group (52%) and a lowest incidence on population older than 55 (6%) (Fig. 4).

Entomological findings

Aedes immature surveys were carried out for four months during the period of the outbreak (September through December) when a total of 585 houses were surveyed from 31 PHCs throughout Puducherry district. *Aedes* breeding was recorded in 348 containers located in 182 houses. A total of 1495 *Ae. Aegypti*(801 urban & 694 in rural) and 302 *Ae. Albopictus*(164 urban & 138 rural) were recorded from the emergence of immature samples.In most of the areas, both *Ae. aegypti* and *Ae. albopictus* were found to coexist with the former in high numbers. All the immature indices House index (HI), container index (CI) &Briteau index (BI) were found high in urban areas in comparisonto rural areas (Table 2).

Periodic outbreak patterns are also highly influenced by seasonal climatic conditions. Thus, these factors are important considerations when assessing the effect of vector control against dengue. The emergence of DF as a major public health problem in India with reports of its outbreaks in\ several parts of the country and all the four serotypes being involved in the epidemics at different places calls for constant surveillance and for generating public awareness and appropriate action by health authorities.

As found in previous studies, the majority of the cases are reported during the monsoon and post-monsoon seasons, in accordance with the reported patterns of dengue transmission (Reiter, 2001).Similarly, in the present study maximum cases were reported during monsoon season in the month of October.

The highest numbers of cases were recorded in the age group 15–34 years and males clearly outnumbered the females. Gupta *et al.* and Chakravarti and Kumaria also reported maximum cases in the age group 21–30 years with male preponderance. Sarkar *et al.* however, reported maximum cases in the age group 0–10 years with female preponderance.

In the absence of data of *Aedes* species breeding indoors and outdoors, it is not possible to demarcate the ecological boundaries of *Ae. aegypti* and *Ae. albopictus.*

Ae. aegypti, with its preference to breed in artificial (man-made) containers and generally encountered indoors, is strongly anthrophilic and accounts for clustering of cases because it bites more than one person due to its nervous nature of feeding. On the other hand, *Ae. albopictus* prefers to breed in natural breeding habitats close to natural vegetation. Since in the present study the emergence of Ae. aegypti (83%) far exceeded that of Ae. albopictus (17%), it is likely that Ae. aegypti played a critical role in the present outbreak in Puducherry

The different calculated larval indices like house index, indoor/outdoor container index and breteau index showed moderate larval growth and hence, the outbreak was within control. Prevalence of disease was more common in urban setting than the rural ones and most of the cases were found in urban and suburban areas.

Table 2 Larval indices of *Aedes* vectors collected during entomological investigation of

Area	House index (HI)	Container index(CI)	Breteau index (BI)	*Aedes aegypti*	*Aedes albopictus*
Urban	33.3	38.2	65	801	164
Rural	30	33.2	54.6	694	138
Total	31.7	35.7	59.8	1495	302

Outbreak

DISCUSSION

Transmission of Dengue virus is mainly influenced by demographic factors viz., population density, occupation, literacy, migration, economic status and health seeking behavior on the occurrence of mosquito-borne diseases at micro level has been described (Sherch and *et al.*, 2003; Galvez, 2003; Sabesan *et al.*, 2006). Similarly, the vector abundance may be depending on the geo-physical and human associated factors, but the vector survival and the virus transmission are greatly determined by the environmental factors at macro level. In the present study, agree with the each of the geo-environmental risk factors was not taken as a separate entity, but all factors have been considered together a composite index (FTRI), since a combination of factors are responsible for transmission (Brooker and Michael, 2000).

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