



Original Article

Epidemiological and Entomological Investigation of an Outbreak of Dengue Fever in Tiruchirappalli Corporation During – 2012

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ARTICLE INFO

A B S T R A C T

Received: 13 Jan 2018
Accepted: 02 Feb 2018

Objectives: 1. To investigate dengue outbreak at Tiruchirappalli Corporation during the year – 2012. 2. To identify the high risk and low risk wards & identify the high risk age groups among dengue affected people. 3. To identify the larval indices of high risk wards at Tiruchirappalli City. Corporation, Tamil Nadu, India (Latitude: between 35°N and 35°S latitude) in 2012.

Materials and Methods: The Epidemiological investigations were carried out in Tiruchirappalli Corporation during the dengue outbreak in the year-2012. In patients presenting with clinical symptoms of dengue fever - both inpatients & outpatients, blood samples were collected. Serological diagnosis done was in the Microbiology department of KAPV Government Medical College, Tiruchirappalli and government authorised private Laboratory. Serodiagnosis by IgM antibody capture Elisa (NIV Kit), NSI antigen test by pan Bio-method and IgM antigen capture Elisa were used. Besides serodiagnosis, haematological parameters & clinical spectrum of the disease were studied. Entomological investigations were carried out in all the wards, based on that, anti-larval and anti-adult control measures were implemented on a weekly cycle to cover all 65 wards in Tiruchirappalli Corporation.

Results: A total of 891 dengue positive patients were reported during the year 2012 in Tiruchirappalli Corporation. Out of these patients 426 were male and 465 were female. High incidence of cases were reported in ward No.37 (48 Nos) and the lowest incidence was in ward No.21 (1 No). Larval indices were studied for 10 numbers of high risk wards. Among these wards the maximum indices were reported in ward No.52 (9.26) & the minimum indices were reported in ward No 57(5). The maximum average indices were reported in ward No.32 (1.28). **Conclusion:** The reason for major dengue outbreak in Tiruchirappalli Corporation during the year 2012 is due to inadequate routine disease surveillance, inadequacy in systematic collection of solid waste including plastics, practice of storing of water for a long period in containers, poor awareness of disposal of household wastes then & there in certain areas of people of Tiruchirappalli Corporation. After conducting intensive source reduction and anti-larval work and fogging operation on weekly cycle there was a reduction of vector density & reduction of case incidence. So, routine source reduction, anti-larval work and mass cleaning may be initiated before the monsoon begins.

Keywords: Dengue fever, *Aedes aegypti*, Dengue vector, Serodiagnosis, anti-larval, indices.

1. INTRODUCTION

Mosquitoes are the primary vectors of vector-borne diseases and nuisance biters that affect human and their livestock¹. Dengue virus is an RNA virus of the family Flaviviridae; genus Flavivirus, which are transmitted in the tropics, in an

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area roughly between 35° north and 35° south latitude corresponding to the distribution of *Aedes aegypti* the principal mosquito vector²⁰. It is transmitted by arthropods (Mosquitoes) and therefore also referred to as arbovirus (arthropod – borne viruses). *Aedes aegypti*, is cosmopolitan, abundant and vector for transmitting several human diseases such as dengue fever, Chikungunya, and Yellow fever². Dengue fever is an important health problem in India with about 2.5 billion people are at risk globally of which a few may progress to dengue haemorrhagic fever (DHF) /dengue shock syndrome (DSS), the major cause of mortality mainly among infants.

In India DF & DHF had been documented in different parts of the country including Southern India (Tamil Nadu). It is a self-limiting disease found in tropical and subtropical regions around the world, predominantly in urban and semi urban areas. Usually urban areas having high population density, poor sanitation and large number of desert coolers, flower vases, construction sites, overhead tanks, discarded utensils, tyres, buckets, etc., which promote mosquito breeding, are at high risk. Dengue fever / DHF can also occur in rural areas where the environment is friendly for mosquito breeding like storage water for cattle feeding and drinking, cement cisterns, water sumps, discarded articles etc., which are not emptied and changed periodically.

Dengue haemorrhagic fever (DHF) a potentially lethal complication was first recognized in 1950s during the dengue epidemic in Philippines and Thailand but today DHF affects most Asian countries and is a leading cause of childhood deaths. WHO currently estimates that there may be 50 million cases of dengue infection Worldwide every year with around 24,000 deaths.

In India dengue has been recognized for many years since the outbreak of dengue occurred in Kolkata during 1912¹⁹. However, the first major outbreak of DHF occurred in India in Kolkata during 1963¹⁷. In South India, all the four serotypes of dengue viruses have been isolated from clinical specimens and also in mosquitoes in Vellore, Tamil Nadu even during early 1960s establishing the activity of different serotypes of dengue in this area^{5,14}.

Further Dengue fever outbreaks were reported in Vellore district during 1966 & 1968 in which several strains of dengue viruses were identified¹⁴. Since then, sporadic occurrence of dengue fever cases have been reported from other parts of the state except a few outbreaks of DF/DHF reported in certain villages of Dharmapuri district & Chennai City. Generally dengue epidemics have been reported in certain areas of Tamil Nadu in recent years. The present investigations were carried out during an outbreak in Tiruchirappalli City Corporation.

Objective of the study:

General objective:

To know the prevalence of dengue fever in Tiruchirappalli Corporation and to know the effect of anti-larval and anti-adult measures taken.

Specific objectives:

1. To know the Endemicity of dengue infection.
2. To identify the high risk wards and low risk wards for dengue affected areas.
3. To identify the high risk age groups.
4. To identify the larval density of high risk and low risk wards.
5. To evaluate the anti-larval and anti-adult measures conducted in the area.

2. MATERIALS & METHODS

The present investigations were carried out during an outbreak in Tiruchirappalli urban, which is located in central Tamil Nadu in South India. Tiruchirappalli Corporation is divided in to 65 wards with a total area 120 Sq .K.M and the total population is 8, 63,475.

Serological Diagnosis

All the fever cases attending the hospitals especially Mahatma Gandhi Memorial Government Hospital & Urban health centres were ruled out for Malaria parasite infections. The patients presenting clinical symptoms suggestive of dengue fever were recommended for dengue serodiagnosis. Since, there is no facility available for performing serodiagnosis in urban health centres and dispensaries of Tiruchirappalli City Corporation, the serum samples collected from clinically suspected patients were sent to Microbiology department of KAPV Govt. Medical College, Tiruchirappalli and Senior Entomologist, Zonal Entomological team office, Tiruchirappalli for serodiagnosis by IgM antibody capture Elisa (NIV Kit), NSI antigen test by pan Bio-method and commercially available NS1 kit (IgM capture Elisa, J. Mithra) to detect dengue virus specific IgM antibodies. Also serum samples collected from both inpatients and out patients of suspected dengue patients in MGM Govt. Hospitals were sent to microbiology department for analysis. However serum samples collected from both in patients and out patients of private hospitals were also tested by Govt. authorized private Laboratory to detect dengue virus specific IgM antibodies.

Besides the serodiagnosis, the haematological parameters such as haematocrit value, platelet count and leucocytes count were also determined for the patients presenting dengue related symptoms and admitted in the hospital.

Entomological Investigations

Both larval and adult mosquito collections were carried out in the urban areas of Tiruchirappalli City Corporation during the epidemic period. Indoor thermal fogging with pyrethrum extract was done against adult mosquitoes using hand operated machines.

Statistical Analysis

Test of significant was applied to find out whether the clinical symptoms between children and adults were significantly different.

3. RESULTS

A total of 891 dengue positive patients were reported during the year 2012. All the patients were taken for the study. Out of 891 patients male were 426 cases and female were 465. Out of 891 cases studied, 316 (35%) cases were positive for IgM Elisa and 575 (65%) cases were NS1 positive.

Out of 575 NS1 positive cases detected 144 cases were detected from Microbiology department of KAPV. Govt. Medical college 195 cases were detected from Zonal Entomological Team and from private Laboratory 236 cases were detected. Out of 316 Elisa positive, Microbiology department of KAPV Govt. Medical College Laboratory detected 177 cases, Zonal Entomological team (ZET) detected 3 cases and 136 cases were detected by Government authorized private Laboratory. Age wise and sex wise distribution of cases are given in (Figure 1) of the 891 cases studied. 410 (46%) cases were children (<14 years) and 481 (54%) cases were adults (> 14 years) ranging from 3 months to 85 years old.

Among the 410 individuals studied less than five years were 161 cases (81 cases were male and 80 were female). Among the different age group the most affected was 11– 20 years (102 cases were male and 130 were female), followed by 21- 30 (87 cases were male and 84 were female). When comparing all these age groups above 60 were less affected (7 cases were male and 11 were female).

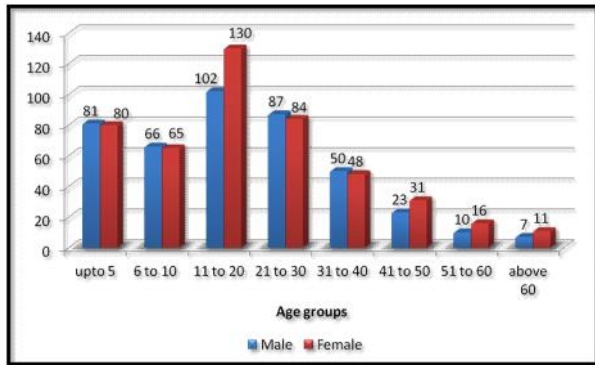


Fig 1: Age and sex wise distribution of cases

As the dengue epidemic occurred for the second time in Tiruchirappalli (Previously Epidemic Occurred in 2003) the clinical spectrum of the disease between the previous outbreak and present outbreak have been correlated. Major clinical symptoms presented by the patients were given (Figure 2; Table.1) vomiting, nausea, drowsiness, petechial, rashes and loss of appetite were reported in significantly higher number in children than adults and myalgia, head ache, Retro-orbital pain and arthralgia were reported in significantly higher number in adults. Hematemesis (0.83%) gum bleeding (0.83%) and malaena (2.6%)(in children) were also reported in the patients. Diarrhoea was reported in 3.4% of children and 5.6% of adults.

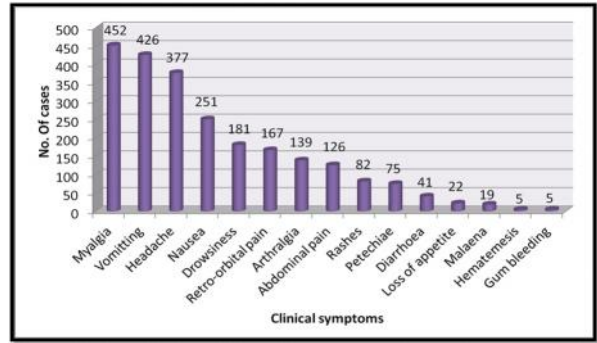


Fig 2: Dengue disease spectrum among patient's during epidemic in Tiruchirappalli –during -2012

Table 1: Clinical features of dengue fever / DHF patients reported in Tiruchirappalli Corporation during 2012

S.No	Clinical symptoms	Children (46%)	Adult (54%)	P value
1.	Vomiting	89.26	12.47	P<0.05
2.	Nausea	42.68	15.8	P<0.05
3.	Myalgia	36.07	63.20	P<0.05
4.	Drowsiness	30.7	11.43	P<0.05
5.	Headache	18.2	62.78	P<0.05
6.	Abdominal pain	16.3	12.2	NS
7.	Petechiae	15.1	2.70	P<0.05
8.	Rashes	14.8	4.36	P<0.05
9.	Retro orbital pain	11.22	25.1	P<0.05
10.	Loss of appetite	3.65	1.45	P<0.05
11.	Diarrhoea	3.4	5.6	NS
12.	Arthralgia	2.92	26.40	P<0.05
13.	Malaena	2.6	1.66	NS
14.	Hematemesis	0.24	0.83	NS
15.	Gum bleeding	0.24	0.83	NS

Dengue fever case was first reported in Tiruchirappalli Corporation during January –2012. In February no case was reported and during March 2012, one case was reported. Again from after 2 months interval from June 2012 onwards dengue cases were in an increasing trend up to November. During December, the dengue cases were started decreasing when it was compared to the previous months (Figure.3).

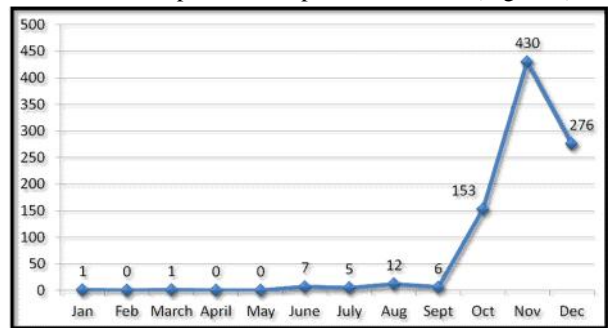


Fig 3: Month wise burden of dengue cases

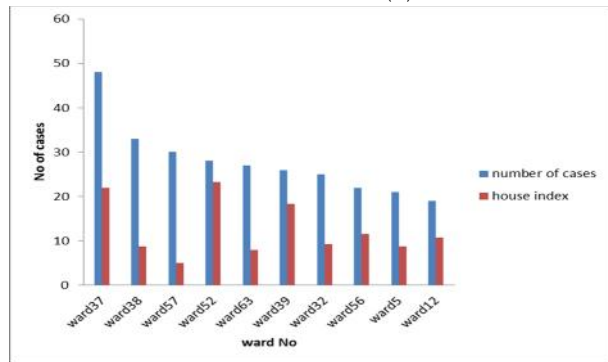


Fig 4: Area wise cases of dengue – Low risk wards and high risk wards

Figure 4 and Table 2 Entomological investigations were carried out. *Aedes* larval survey was conducted in domestic and peri-domestic breeding habitats & it was found that water storage containers and unused plastic and iron containers were the major breeding sites for the *aedes* mosquitoes. The high dengue incidence of case was reported in ward No.37 (48 cases) and the lowest dengue incidence was in ward No.12 (23 cases). The highest number of house index were seen in ward no 52, lowest were observed in ward no 57.

Table 2: High risk ward wise range of larval indices (house index) during October to December -2012 in Tiruchirappalli Corporation

S.No	Ward No	Minimum indices	Maximum indices	Average larval indices
1.	37	2	22	12
2.	38	2	8.8	5.18
3.	57	1.3	5	3.58
4.	52	2	23.3	9.26
5.	63	1.8	8	4.9
6.	39	1.25	18.3	6.65
7.	32	1.8	9.3	1.28
8.	56	1.3	11.6	5.76
9.	5	2.5	8.8	3.49
10.	12	2.5	10.8	4.4

Table 2 explains minimum and maximum of house indices. As in the Figure 4 the highest average larval indices were seen in ward no 52 (9.26%) followed by the lowest average house indices were seen in ward no 57 (3.58%). Identification of adult mosquitoes revealed that *Aedes aegypti* was the only aedine species prevalent in Tiruchirappalli urban area.

Table 3: Adult density *Aedes aegypti* in Tiruchirappalli urban during – 2012

Adult density	June	September	October	November	December
Per man hour density (PMHD)	8	4.5	2.5	1.5	

Table 3 describes the adult density of *Aedes aegypti*. During June to September 2012 Per Man Hour Density (PMHD) of adult *Aedes aegypti* was 8 followed by Oct 4.5, Nov 2.5 and finally Dec 1.5. Both larval and adult densities were found to have remarkably reduced after implementation of anti-larval

and indoor thermal fogging operations against vector mosquitoes.

4. DISCUSSION

Dengue epidemics have been reported in certain areas of Tamil Nadu in recent years. Dengue fever and dengue haemorrhagic fever outbreaks have been reported in Tamil Nadu since 1990s in Vellore ⁷, Dharmapuri ^{16, 12} districts and Chennai City ¹¹. However, sporadic occurrences of dengue fever cases have been reported in many areas in Tamil Nadu. First outbreak of dengue haemorrhagic fever was reported during 2003 ¹⁸ in Tiruchirappalli for the first time. After that sporadic cases were reported till 2011. During 2012 it was the second dengue fever outbreak reported in Tiruchirappalli Corporation. Since there was an acute scarcity of water in the corporation area which restricted the water supply in certain wards in the city. Therefore, people had to store the water for their routine domestic purpose and this has resulted in abundance of *Aedes aegypti* mosquitoes breeding.

The dengue cases were initially confined to certain areas of the Corporation sporadically and gradually extended to other areas also. Following that many cases were reported in adjacent wards. Daily dengue fever positive cases were collected from all the private hospitals and Govt. hospitals by the special surveillance team constituted with the health inspectors. The positive case details were daily informed to the concerned Medical officers of urban health centres and assistant commissioners of each zone, so as to take preventive measures immediately in the area and to follow up the cases. In the present study 891 cases were reported in Tiruchirappalli Corporation area. The male female ratio in this study was 0.9: 1 and the male female ratio in Delhi was 2.3: 1.

In the present study the most affected age group was 11-20 years (26%) among the different age group studied. The age group 11-30 years was the most affected in DHF outbreaks occurred in Kanpur ⁶ and in Lucknow ³ and in Punjab 21-40 years age group was most affected in the outbreak ¹³. 26-30 years age group was most affected in Delhi and 10-20 years age group was most affected in Tiruchirappalli during 2003 when the first dengue outbreak occurred ¹⁸.

In the present investigation, it was found that clinical features such as vomiting (48%) myalgia (51%) head ache (42%) and skin rashes (9.2%) were observed in dengue patients reported in Tiruchirappalli corporation area. But in previous dengue fever outbreaks in Tiruchirappalli during 2003 it was vomiting (54%) myalgia (25.1%) head ache (35.2%) and skin rash (8.8%) were observed ¹⁸. But in an outbreak in Lucknow ³ it was found that vomiting, myalgia, head ache and skin rashes were observed in 29%, 90%, 97% and 40% of the patients respectively. Convulsion was reported only one child in the present study, whereas in Thailand infants presented more frequently convulsion (26%) and diarrhoea (39%) and rash (33.8%). Occurrence of convulsion in children may be due to high-grade fever. The

present study the predominant dengue virus serotypes seen were dengue 1 and 3, where as in Delhi during 1996 dengue epidemic was mainly due to dengue 2 virus^{4, 8} and in 1997 dengue -1 virus activity was seen¹⁵. Whereas during 2003 in Delhi all the four dengue virus serotypes were found to be co-circulating^{10,9}.

Besides anti larval measures such as source reduction of breeding sites and application of Temephos, intensive fogging operations were planned systematically. For source reduction and anti -larval work activities field workers of Tiruchirappalli Corporation and self-help group in the concerned area, staffs from nutrition department, multipurpose health workers of urban health centres and nursing students from the private Nursing colleges, NSS students from the colleges and schools were utilized. The anti -larval work was supervised, guided and cross checked by the Corporation Commissioner, Medical officers from urban health centres and dispensaries, CDPOs, Assistant Commissioners of Corporation and Doctors and Entomologist specially deputed from Government Medical College, Tiruchirappalli. IEC meeting was convened in all the four zones of Tiruchirappalli Corporation regarding to create dengue fever awareness. Dengue fever awareness meeting was conducted to all the Corporation school teachers, SHG members, and CNC staff to create awareness to the public. Special awareness meeting was conducted to the school students in order to carry out source reduction activities in their school campus as well as in their houses. Every week one day (Thursday) was observed as a mass cleaning day and the source reduction and anti -larval work was conducted in all the wards on weekly cycle and thus unwanted materials, tyres, whichever causes the aedes breeding sources were collected and removed from the area. The above activities were carried out from October 2012 onwards. Wherever the water scarcity was found, bore well pipes were offered and daily supply of water, through Lorries were also arranged. Special mobile medical teams were organized to treat the symptomatic patient in the area itself. Special fever Out Patient was conducted in all the urban health centres and dispensaries and the suspected dengue fever patients were referred to Mahatma Gandhi Memorial Government Hospital for admission and for further management. Fogging operations were conducted in all the wards on weekly cycle. Due to the above activities there was a reduction of vector density and also there was a reduction of case incidence from the second fortnight of December 2012. Importance to be given for source reduction apart from garbage removal during weekly mass cleaning work. Intensive mass cleaning is to be done before monsoon by covering all the wards. Unused plastic trays and polythene bags present in Aavin dairy campus, tyres from the transport office and unwanted materials from Railway work shop campus, plays a major role in breeding of aedes mosquitoes. Since the periodical source reduction and disposal of waste materials is to be done. All the major

hospitals should stock the drugs required for the management of DHF/DSS cases. Since, Tiruchirappalli Corporation has become an endemic area for dengue fever, a constant vigil should be maintained always and the above mentioned preventive measures is to be taken and followed up.

5. CONCLUSION

In summary, the occurrence of dengue epidemic during 2012 in Tiruchirappalli urban might have been aggravated by lack of routine hospital surveillance in the urban area and lack of routine source reduction and anti- larval work in all the wards. After conducting intensive source reduction and anti- larval work and fogging operation on weekly cycle, there was a reduction of vector density and reduction of case incidence, from the second fortnight of December – 2012 onwards.

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Conflict of Interest: None

Source of Funding: Nil