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Seroprevalance of Dengue and Chikungunya Infection and their Seasonal Trends

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Abstract

Dengue and Chikungunya are mosquito-borne arboviral infections with *Aedes aegypti* being the common vector for both. Manifestations of dengue fever closely resemble with the manifestations of Chikungunya. Although Chikungunya is a self-limiting disease, but dengue causes serious complications like Dengue Hemorrhagic Fever and Dengue Shock Syndrome. Detection of IgM antibody in Dengue and Chikungunya infection helps in early diagnosis and treatment. To study the Prevalence and Seasonal Trends of Dengue and Chikungunya infection. Two years retrospective study was conducted from January 2017 to December 2018. Serum samples from patients who were clinically suspected to have Dengue and Chikungunya were included. Samples were subjected to IgM antibody capture ELISA kits produced by NIV (Arbovirus Diagnostic NIV, Pune, India). The tests were done according to manufacturer's instruction. In 2017, Of 1664 samples tested for Dengue, 158(09.49%) were positive and of 1439 samples tested for Chikungunya, 147(10.21%) were positive. In 2018, of 737 samples tested for Dengue, 48 (6.51%) were positive and of 711 samples tested for Chikungunya, 90 (12.6%) were positive. Maximum numbers of Dengue and Chikungunya cases were seen in the age group of 21 to 30 years and 11-20 years respectively. Males were affected higher than females. Maximum seropositives were detected during Monsoon and Pre-monsoon season.The serological tests (ELISA) clearly establish the etiology and also help in initiating appropriate treatment and preventive measures in community.

Keywords: Dengue, Chikungunya, IgM antibody capture ELISA

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INTRODUCTION

Dengue and Chikungunya are mosquito-borne, fast emerging pandemic-prone viral disease in many parts of the world. It mainly affects in urban, suburbans and the countryside and also affects in tropical and subtropical countries[1]. In the Philippines and Thailand in 1950s dengue was first identified and chikungunya was first recognized in the year 1952 in southern Tanzania during an outbreak. The dengue virus belongs to the genus Flavivirus, family Flaviviridae and has four serotypes (DEN-1, DEN-2, DEN-3 and DEN-4). Chikungunya is an RNA virus that belongs to the alphavirus genus of the family Togaviridae[2,3]. These infections are transmitted by bite of various species of female mosquitoes. *Aedes aegypti* is the principle vector followed by *Aedes albopictus*. Hence, the infections are usually seen in same geographical areas[4]. These mosquitoes bite during the day time (early morning and late afternoon). The symptoms of both the infections closely resembles which includes Fever, Severe headache, Nausea, Vomiting, Muscle and joint pains, Pain behind the eyes, Rash and Swollen glands. Although Chikungunya is a self-limiting disease, but dengue causes serious complications like Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) which mainly affects children less than 12 years and most commonly with serotype 1[5].

An unusual rainfall pattern (heavy rains, deficient rains and burst in rainfall) is reflecting climate change worldwide. Few studies showed that some southern states of India are facing variations in climatic change which is affecting individuals health directly or indirectly[6,7]. An element of climate change like increase in average temperature supports the breeding and spread of vectors (*Aedes species*) which results in increase in dengue and Chikungunya infection rate[8]. Higher incidences are the reasons for increased morbidity and mortality worldwide[9]. Globally, >2.5 billion people are at risk and 50–100 million infections per year are likely, out of which 5 lakh cases proceed to DHF[10].

Environmental conditions like season, temperature, rainfall and humidity is a major factor for the distribution of the vectors in particular geographical areas[11–13]. Vector survives best between the temperature of 16°C and 30°C and humidity of 60-80%. Water storage in the open containers surrounding the houses supports the breeding of *A. Aegypti*[14]. Artificial manmade breeding sites are the main reason for outbreaks at new locations.[15,16] The priority should be early diagnosis of the infection which allows timely management of the patient, epidemiological survey and implementation of control measures.

In order to detect these cases, there are various tests available like antigen detection tests (Non- structural 1 antigen- NS1 antigen), IgM and IgG antibody detection, virus isolation, immunofluorescence or by identification of viral RNA by nucleic acid amplification tests (NAAT). NS1 antigen detection for Dengue and IgM, IgG detection which detects these infections are easy to do and cheap. Moreover NS1 antigen becomes detectable from day one of fever and remains positive upto 18 days and hence helps in early diagnosis and prompt treatment[17]. Adequate serologic and virologic tests helps in the differential diagnosis of various febrile illnesses[18].

Aim of our study is to know the seroprevalance of Dengue and Chikungunya along with seasonal trends of these infections.

MATERIALS AND METHODS

The retrospective study was done at a District hospital attached to Chamarajanagar institute of medical sciences, Chamarajanagar for a period of two years i.e, from January 2017 to December 2018.

Blood samples were collected from suspected cases of Dengue and/or Chikungunya infections.

In 2017 out of 3103 samples, 1664 samples were subjected to Dengue testing and 1439 samples for Chikungunya and in 2018 of 1448 samples received, 737 samples were tested for dengue infection and 711 samples for Chikungunya. Samples were subjected to IgM antibody capture ELISA kits produced by NIV (Arbovirus Diagnostic NIV, Pune, India). Tests were carried out according to manufacturer's instruction. Data were collected from microbiology lab registers.

Statistical analysis

Analysis was done using MS Excel.

Ethical considerations

Ethical clearance was obtained from

Institutional Ethical Clearance Committee, Chamarajanagar Institute of Medical Science, Chamarajanagara.

RESULTS

Total of 3103 samples were tested for Dengue and Chikungunya. Out of 3103 samples received, 1664 were subjected to Dengue and 1439 to Chikungunya in 2017. In 2018 of 1448 samples received 737 samples were subjected to Dengue and 711 samples to Chikungunya. Overall seroprevalence of Dengue in our study in 2017 and 2018 was 9.49% (158/1664) and 6.51% (48/737) respectively and of Chikungunya was 10.21% (147/1439) and 12.6% (90/711) respectively. [Table-1] shows seroprevalence of Dengue and Chikungunya of the year 2017 and 2018.

Males were predominantly high-flown to Dengue infections in the year 2017 and 2018 and in Chikungunya infections, in the year 2017, Males were affected higher than female. But in the year 2018, males and females were equally affected. Gender-wise distribution is shown in [Table-2].

In 2017, Adults in the age range of 21 to 30 years were commonly involved than any other age range in both infections, which is shown in [Table-3]. In 2018, maximum cases were seen in the age group of 11-20 years as compared to any other age group in both the infections, which is shown in [Table-4]

In 2017 and 2018 Dengue infection was peak in the month of September 46 (29.1%) and April 12 (25%) and Chikungunya infection was peak in the month of July 47 (31.9%) and

Table 1. Seroprevalance of Dengue and Chikungunya infection

Samples Tested	Dengue IgM no.s (%) –2017	Chikungunya IgM no.s (%) -2017	Dengue IgM no.s (%) –2018	Chikungunya IgM no.s (%) –2018
Positive samples	158 (9.49%)	147 (10.21%)	48 (6.51%)	90 (12.6%)
Negative samples	1506 (90.50%)	1292 (89.78%)	689 (93.4%)	621(87.3%)
Total	1664 (100%)	1439 (100%)	737 (100%)	711 (100%)

Table 2. Gender distribution of Dengue and Chikungunya infection

Gender	Dengue no.s (%) – 2017	Chikungunya no.s (%) – 2017	Dengue no.s (%) – 2018	Chikungunya no.s (%) – 2018
Male	88 (55.6%)	80 (54.42%)	25 (52%)	45 (50%)
Female	70 (44.3%)	67 (45.57%)	23 (48%)	45 (50%)
Total	158 (100%)	147 (100%)	48 (100%)	90 (100%)

Table 3. Age-wise distribution of Dengue and Chikungunya infection 2017

Age group (years)	Dengue no.s (%)	Positives	Chikungunya no.s (%)	Positives
0-10	191 (11.4%)	13 (8.2%)	198 (13.7%)	22 (14.96%)
11-20	385 (23.1%)	14 (8.8%)	328 (22.7%)	11 (7.48%)
21-30	421 (25.3%)	75 (47.4%)	370 (25.7%)	53 (36.05%)
31-40	315 (18.9%)	27 (17%)	255(17.7%)	32 (21.7%)
41-50	167 (10%)	10(6.3%)	147(10.2%)	09 (6.12%)
51-60	124 (7.4%)	07 (4.4%)	83(5.7%)	05 (3.40%)
61-70	43 (2.5%)	05 (3.1%)	38 (2.6%)	08 (5.44%)
>71 yrs	18 (01%)	07 (4.4%)	20 (1.3%)	07 (4.76%)
Total	1664 (100%)	158 (9.49%)	1439 (100%)	147 (10.21%)

Table 4. Age-wise distribution of Dengue and Chikungunya infection 2018

Age group (years)	Dengue Samples tested no.s (%)	Positives no.s (%)	Chikungunya Samples tested no.s (%)	Positives no.s (%)
0-10	85 (11.5%)	04 (8.3%)	72 (10.1%)	10 (11.1%)
11-20	164 (22.2%)	13 (27%)	152 (21.3%)	24 (26.6%)
21-30	187 (25.3%)	11 (22.9%)	186 (26.1%)	21 (23.3%)
31-40	126 (17%)	11 (22.9%)	129 (4.0%)	20 (22.2%)
41-50	93 (12.6%)	06 (12.5%)	94 (13.2%)	08 (8.8%)
51-60	50 (6.7%)	00 (0%)	48 (6.7%)	04 (4.4%)
61-70	18 (2.4%)	00 (0%)	17 (2.3%)	01 (1.1%)
> 71 yrs	14 (1.89%)	03 (6.25%)	13 (1.82%)	02 (2.2%)
Total	737 (100%)	48 (6.51%)	711 (100%)	90 (12.6%)

Table 5. Month wise distribution of Dengue and Chikungunya infection in 2017 and 2018

Month	Dengue IgM		Chikungunya IgM	
	2017 No.(%)	2018 No.(%)	2017 No.(%)	2018 No.(%)
January	00	03 (6.2)	00	03 (3.3%)
February	00	02 (4.1%)	00	07 (7.7%)
March	00	04 (8.3%)	00	03 (3.3%)
April	00	12 (25%)	00	31 (34.4%)
May	17 (10.7%)	02 (4.1%)	05(3.40%)	04 (4.4%)
June	09 (5.6%)	10 (20.8%)	36(24.4%)	16 (17.7%)
July	26 (16.4%)	05 (10.41%)	47(31.9%)	13 (14.4%)
August	34 (21.5%)	05 (10.41%)	23(15.6%)	02 (2.2%)
September	46 (29.1%)	02 (4.1%)	25(17%)	05 (5.5%)
October	07 (4.4%)	00 (0%)	04(2.7%)	01 (1.1%)
November	12 (7.5%)	01 (2%)	07(4.7%)	01 (1.1%)
December	07 (4.4%)	02 (4.1%)	00(0%)	04 (4.4%)
Total	158 (100%)	48 (100%)	147 (100%)	90 (100%)

April 31 (34.4%) which is shown in the [Table- 5] respectively.

DISCUSSION

Aedes aegypti mosquito pass on both the Dengue and the Chikungunya virus. Clinical features are shared by both infections during the acute phase like fever, joint and bone pain, nausea, vomiting, headache, and fatigue. Clinical features of Dengue and Chikungunya are similar but their outcome differs. In 2013, the fifth serotype (DEN-5) was discovered from Bangkok. Chikungunya is mostly nonfatal while dengue can cause severe illness including death[5].

In India the disease is prevalent in almost all states and union territories. Between 2010-17, >6 lakh cases with >1560 deaths have been reported from West Bengal, Tamilnadu, Punjab, Kerala, Delhi, Karnataka, and Maharashtra. Of 1,57,220 cases reported in 2017, maximum were reported from Tamilnadu followed by West Bengal isolating all four Dengue serotypes. Serotype prevalence varies between seasons and places, but DEN-1 and DEN-2 are widespread. DEN-5 has not been reported yet.

In our study Dengue prevalence was (9.49%) and (6.51%) (Table-1) which correlates with the study of Shashi sharma sudhan et.al. who reported the prevalence of 21/229 (9.1%) of Dengue[2] and Chikungunya prevalence was (10.21%) and (12.6%) (Table-1) which correlates with the study of Anju Dinkara et.al. who reported

prevalence of 23 (12.37%) cases for chikungunya[19].

In our study Dengue positivity was predominantly between the age range of 21-30 years i.e. (47.4%) in 2017 and 11-20 years i.e. (27%) in 2018. Our study correlates with the study of Arvind Neralwar et,al. who reported the majority of the dengue illness between the age group of 21 to 30 years (41.44%)[17]. Chikungunya positivity was also predominant in the age range of 21-30 years i.e. (36.05%) in 2017 and 11-20 years i.e. (26.6%) in 2018 which correlates with the study of Modi K.P. et al. who reported the majority of the dengue illness between the age group of 21 to 30 years 279 (35.09%)[5].

In our findings we can observe the age shift in the dengue and chikungunya patients from being in adults (21–30 years) to children and young adolescents (11–20 years). Singapore, Indonesia, and Thailand studies suggested that individuals developed multitypic immunity following exposure to different serotypes. Over a period of time as co-circulation of different serotypes increases, individuals remain lesser susceptibility to infection. Hence, younger age group individuals become completely susceptible. Therefore, individuals immune to specific serotype are more likely to be from younger age groups[20].

In our study Dengue positivity was predominantly in the males i.e, (55.6%)-2017, (52%)-2018 which correlates with the study of Arvind Neralwar which has shown a male preponderance of 63.19% in the clinically suspected dengue patients[17]. and Chikungunya positivity was predominantly in the males i.e, (54.42%) in 2017 which correlates with the study of Usha Kalawat et.al, which has shown male preponderance of 96 (56%) in the clinically suspected Chikungunya patients[21]. But in 2018, Chikungunya was equally affected in both male and female. i.e. (50%) in each. The reason for the excess of reported male dengue and chikungunya cases is observed in this study can be due to day time working hours and their exposure to dengue and Chikungunya carrying mosquitoes.

In our study, the suspected Dengue infection was peak in the monsoon season i.e. in the month of September, (29.1%) in 2017 and June (20.8%) in 2018. Similarly, our study correlates with the study of Sujet Lertanekawattana et.al, in which dengue cases decreased after the last week of July; however, reached its highest point in mid-August and cases continued until the end of September[22]. Chikungunya infection was peak in monsoon and pre-monsoon i.e. in the month of July,(31.9%) in 2017 and April (34.4%) in 2018. Our study correlates with the study of Akanksha Tomar et al. Here, a seasonal peak of Chikugunya infection was seen in the months of July to September, while showing major decline in other seasonal months[23]. *Aedes aegypti* is sensitive to climatic changes like temperature and moisture. Increased temperature and wet season favours its survival whereas dry and cool seasons does not[21].

Clinically suspected cases should be tested for both Dengue and chikungunya infections especially in endemic areas, as the signs and symptoms of these infections overlap. As a result of urbanization in India, there is increase in the incidence of dengue infection. Hence continuous surveillance of these viruses will help for its identification and characterization. This information will also help to control outbreak by implementing effective control measures[5].

CONCLUSION

The Dengue and Chikungunya are the most common arboviral infections. These infections continue to co-exist in our country and there is substantial overlap in clinical presentation between these infections. So, simple clinical criteria along with lab investigations will help for appropriate management of these infections. The serological results (IgM antibody capture ELISA) clearly establish the etiology. The findings of age shift may be of help to the epidemiologists, paediatricians, and prevention of Dengue and Chikungunya infections and control measure targeting the young population.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

PC drafted the manuscript, compiled the information and designed the tables. MDW and JS gathered information. SJV supervised and reviewed the manuscript and tables.

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None.

ETHICS STATEMENT

Ethical clearance was obtained from Institutional Ethical Clearance Committee, Chamarajanagar Institute of Medical Science, Chamarajanagara, India.

DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

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