A three year retrospective study on the increasing trend in seroprevalence of dengue infection from southern Odisha, India

Sanghamitra Padhi, Muktikesh Dash, Pritilata Panda, Banojini Parida, Indrani Mohanty, Susmita Sahu & M.V. Narasimham

Department of Microbiology, Maharaja Krushna Chandra Gajapati Medical College & Hospital, Berhampur University, Berhampur, India

Background & objectives: In Odisha, several cases of dengue virus infection were detected for the first time in 2010, the importance of dengue as a serious mosquito-borne viral infection was felt only in 2011 with the reporting of many more positive cases. This retrospective three year study was done to find out the seroprevalence of dengue IgM antibody and to know the predominant serotype of dengue virus among the patients suspected to have dengue virus infection in a tertiary care hospital in southern Odisha, India.

Methods: Blood samples from clinically suspected dengue cases admitted in the Medicine and Paediatrics departments of a tertiary care hospital were collected. These were processed for detection of dengue specific IgM antibody, carried out by the ELISA method. Dengue IgM antibody positive serum samples were tested for serotypic identification.

Results: Of the 5102 samples tested, 1074 (21.05 %) were positive for dengue IgM. Maximum numbers of cases were found in 2012. Majority (47.86 %) of cases were detected in the month of September. The most common affected age group was 11 to 20 yr. DENV1 and DENV2 were the detected serotypes.

Interpretation & conclusions: Rapid increase in the dengue cases in 2012 became a public health concern as majority of cases were affecting the young adolescents. Most of the cases were reported in post-monsoon period indicating a need for acceleration of vector control programmes prior to arrival of monsoon.

Key words Dengue virus - IgM antibody - seroprevalence - serotype - vector control

Dengue virus belonging to the family "Flaviviridae", consists of ten proteins, three of which are structural and seven non-structural, and it has four serotypes, namely DENV1, DENV2, DENV3 and DENV4. These arboviruses are transmitted by the mosquitoes; *Aedes aegypti* and *Ae. albopictus*[1,2]. *Ae. albopictus* breeds in a wide variety of natural and artificial habitats, though their resting occurs in outdoors and biting occurs both in outdoor as well as indoor[3].

Although dengue has a global distribution, South-East Asian regions together with Western Pacific region bear nearly 75 per cent of the current global disease burden[4]. In India, with the occurence of first epidemic from Kolkata (1963), the disease was later reported from Vishkapattanam (1964), Vellore (1968), Ajmer (1969), Kanpur (1969), Jalore of Rajasthan (1985), Chandigarh (2002), Mumbai (2004), Ludhiana (2007), New Delhi (1996, 2003, 2006, 2010), Chennai (2006-2008) and Kerala (2008)[4-6]. Odisha State in 2010, enrolled its name for the first time in the list of States showing mortality due to dengue virus infection, with the reporting of 25 cases and five deaths[7].

Early diagnosis of dengue virus infection is important for treatment and aversion of complications like dengue shock syndrome (DSS) and dengue haemorrhagic fever (DHF). Dengue virus specific IgM antibodies appear as early as three days of dengue viral fever and can persist for 30-60 days, whereas IgG antibodies appear at about seventh day, peak at 2-3 wk and persist for life[8].

This retrospective study was done to analyze the trend of the disease during 2010-2012 and identification of circulating dengue virus serotypes among the patients admitted to a tertiary care hospital in south Odisha.

Material & Methods

This retrospective study was carried out among clinically suspected dengue patients admitted in the departments of Medicine and Paediatrics of Maharaja Krushna Chandra Gajapati Medical College and Hospital, Berhampur, Odisha. The clinical diagnosis of dengue virus infection was based on the WHO definitions[9]. Probable dengue fever (DF) is defined as acute febrile illness with two or more of the following manifestations: headache, retro-orbital pain, myalgia, arthralgia, rash, haemorrhagic manifestations, and leucopenia. Confirmed DF is a case confirmed by laboratory criterion[10].

Laboratory criterion for confirmation of DF included any one of the following: isolation of dengue virus from serum or autopsy samples; demonstration of a four-fold or greater change in reciprocal IgG or IgM to one or more dengue viral antigens in paired serum samples or demonstration of dengue virus antigen in autopsy tissue, serum, or cerebrospinal fluid samples by immunohistochemistry, immunofluorescence or ELISA; or detection of dengue virus genomic sequences in autopsy tissue, serum or cerebrospinal fluid samples by polymerase chain reaction[10].

Although NS1 antigen can be detected from as early as one day post onset syndrome, it is positive only upto 18 days[11]. As this study was conducted in a tertiary care hospital, most cases were referred from the peripheral health centers, among whom some with fever of more than 2-3 wks duration were also noticed. On the other hand, dengue IgM antibody is a marker of recent infection, detection of which is easy, simple and less time-consuming as compared with other serological methods[8]. Moreover, it can be detected from as early three days to 60 days of infection. Though dengue IgM detection is a commonly performed test for diagnosis of dengue, it has limitations due to cross-reactivity between other circulating flaviviruses.

Patients presenting as probable DF having fever for more than three days were included in the study group. A total of 5102 blood samples were reviewed over a period of three years from January 2010 to November 2012. Using strict aseptic precautions, about 3 ml blood was collected from each patient. This study was approved by the Institutional Ethical Committee. In the department of Microbiology, serum was separated using the standard methods and subjected to IgM antibody testing by dengue IgM antibody capture ELISA test kit supplied by the National Institute of Virology, Pune.
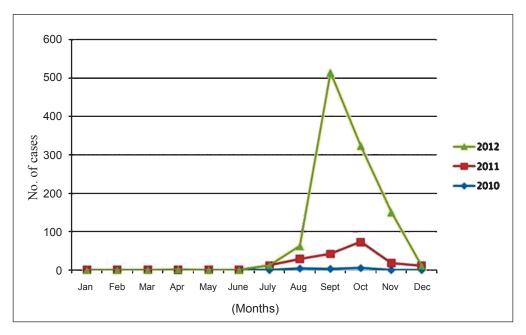
Due to lack of facility for genotypic study, serotypic characterization could not be done in 2010 and 2011. But in 2012, 35 of the randomly selected dengue IgM positive serum samples were sent to Regional Medical Research Centre (RMRC), Bhubaneswar, for serotypic identification.

Statistical analysis: Fisher's exact test and (GraphPad Software Inc.) was used for data analysis.

Results

In this three year study, a total 5102 serum samples were analyzed, among which dengue IgM antibodies were detected in 1074 (21.05%) cases. Year-wise distribution of dengue IgM positive cases over the

Table I. Year-wise distribution of dengue cases			
Year	Total no. of samples processed	Total no. of dengue positive cases	Percentage
2010	85	12	14.11
2011	1145	173	15.01
2012	3872	889	22.96
Total	5102	1074	21.05

Fig. Seasonal variation of dengue cases during the study period.

Age group in years	Male			Female		
	Total no.	Total IgM positive (%)	*P* value	Total no.	Total Ig M positive (%)	*P* value
0-10	218	35 (16.05)	0.168	170	19 (11.17)	<0.01
11-20	790	263 (33.29)	<0.001	362	154 (42.5)	<0.01
21-30	832	209 (25.12)	0.042	516	138 (26.7)	0.039
31-40	534	78 (14.6)	<0.01	416	53 (12.7)	<0.01
41-50	382	45 (11.7)	<0.01	266	23 (8.64)	<0.001
51-60	272	22 (8.1)	<0.001	136	17 (12.5)	0.045
>60	147	12 (8.1)	<0.01	51	6 (11.76)	0.215
Total	3175	664 (20.9)		1927	410 (21.2)	

Table II. Age and sex wise distribution of cases

Comparison between age groups and total number of cases in both male and female was done by using 2 into 2 contigency Table and applying Fisher's exact test

three year period is shown in Table I. Highest number of cases (889), were seen in 2012, whereas lowest number (12) was seen in 2010. Seasonal trend in each year showed that there were almost no positive cases from January to June; the infection started spreading in August, reaching its peak in September and October and slowly declined by December. Majority of the cases 514 (47.86%) were found in the month of September (Figure). In our study, 21.2 per cent of dengue IgM seropositivity was noticed among females while 20.9 per cent among males. Though majority of the patients belonged to 11-20 yr age group followed by 21-30 yr age group (Table II). Among the 1074 detected cases, 1048 (97.58%) presented with dengue fever (DF), 24 (2.24%) with dengue haemorrhagic fever (DHF) and two (0.18%) with dengue shock syndrome (DSS) (Table III).

Thirty five serum samples were tested by reverse transcription polymerase chain reaction (RT-PCR) at RMRC, Bhubaneswar. Of these, two cases with co-infection with DENV1 and DENV2, and one case of DENV2 infection were noticed.

		Table III. Clinical presentation of cases		
Year	DF no. (%)	DHF no. (%)	DSS no. (%)	Total no.
2010	11 (91.66)	1 (8.34)	-	12
2011	169 (97.68)	4 (2.32)	-	173
2012	868 (97.63)	19 (2.13)	2 (0.24)	889
Total	1048 (97.58)	24 (2.24)	2 (0.18)	1074

DF, dengue fever; DHF, dengue haemorrhagic fever; DSS, dengure shock syndrome

Discussion

In this three year study, a sudden and rapid increase in number of dengue cases was observed in 2012 compared to the previous two years. Increased travel among people to neighbouring States for the purpose of jobs and trades might be responsible for the spread of the disease. Also, rapid unplanned urbanization with heavy construction activities and poor sanitation facilities contribute to fertile breeding grounds for the mosquitoes.

The maximum number of dengue cases seen in the month of September indicated an active viral transmission during monsoon and post-monsoon period as reported earlier[12,13]. A higher occurrence of dengue infection was noted among females which is similar to a study conducted in Chennai[5]. However, this was discordant with other studies where a male predominance was noticed[4,14]. More number of patients belonged to the age group of 11 to 20 yr followed by 21 to 30 year which was consistent with studies conducted in different parts of India[15,16]. In a study conducted in Delhi 21 to 30 yr age group was most commonly affected and another study conducted in Kanpur, showed 0 to 15 yr age group to be commonly affected[4,17]. In this retrospective study, DF was found to be the most common presentation which was similar to a study conducted in Delhi[10]. It is an established fact that complications like DHF and DSS occur mainly in cases with secondary infections due to antibody mediated immune enhancement, cross reactive T – cell response with activation of TH-2 lineage cell and stimulation of soluble factors[18].

Both the DENV1 and DENV2 serotypes were found to be circulating in this region. Though DENV1 was found in 1997 outbreak in New Delhi, all the four types were responsible for 2003 outbreak. DENV3 was the predominant one in 2005 outbreak[19]. DENV2 was associated with the outbreaks in Jammu, Haryana, Delhi, Luckhnow and epidemic in Gujarat[20].

This study reported an increasing trend in seroprevalence of dengue virus infection affecting the young children and late adolescents. Both DENV1 and DENV2 serotypes were found. There is a need to develop vaccines that can protect against all the four serotypes. As most cases were reported during post monsoon period, continued and coordinated efforts should be made to control the transmitting vectors to prevent dengue outbreaks.

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Reprint requests: Dr Sanghamitra Padhi, Assistant Professor, Department of Microbiology, Maharaja Krushna Chandra
Gajapati Medical College & Hospital, Berhampur 760 004, Odisha, India
e-mail: padhisanghamitra@yahoo.in