Dengue fever in a rural area of West Bengal, India, 2012: an outbreak investigation

Dilip K Biswas¹, Rama Bhunia², Mausumi Basu³

ABSTRACT

Background: During September 2012, an increased number of fever cases was reported from Ramnagar-II block, Purba Medinipur district. This study investigated the outbreak, with the following objectives: to describe the distribution of fever cases, to determine the risk factors and to recommend preventive measures.

Materials and Methods: The clinical features, date of onset and outcome of all cases of fever were listed. Blood specimens were collected from affected patients and sent for serological examination. An epidemic curve was plotted and environmental and entomological surveys were carried out.

Results: There was a total of 100 cases, of which 56% (56/100) were men. Among the four villages studied, the highest number of cases was from Gopalpur 37% (37/100), followed by Badalpur 26% (26/100); 19% (19/100) of cases had a history of migration from dengue-endemic areas. The majority of cases were in age group 15–45 years – 52% (52/100), followed by the age group >45 years – 28% (28/100). All the cases had history of fever (100%), followed by myalgia – 82%, headache – 78%, and retro-orbital pain – 73%. The outbreak started on 7 September 2012, peaked on 18 September, then gradually declined and no further cases were noted after 28 September 2012. Seventy-nine per cent (79/100) of cases were NS1 test positive (non-structural antigen-1) and 72% (13/18) cases were positive on a dengue monoclonal antibody (IgM) capture enzyme-linked immunosorbent assay (MAC-ELISA) test. All recovered except one (case-fatality ratio: 1%). The values for Household Index, Container Index and Breteau Index of the four villages were: Badalpur, 3%, 10% and 5%; Gopalpur, 13%, 23% and 18%; Ramchandrapur, 9%, 11%, and 13%; and Tajpur, 2%, 2% and 2%.

Conclusion: The outbreak was probably due to dengue fever. The study led to a recommendation to destroy water containers and use mosquito nets. The outbreak was controlled.

Key words: dengue, outbreak, rural area, West Bengal

INTRODUCTION

Dengue is a mosquito-borne viral disease found in tropical and subtropical regions.¹ Over 2.5 billion people, 40% of the world population, are at risk of dengue fever.² According to the National Vector Borne Diseases Control Programme (NVBDCP), the number of cases in India has escalated steadily, from 3306 in 2001 to 50 222 in 2012; deaths have risen from 53 in 2001 to 242 in 2012.³ In West Bengal, 3306 confirmed dengue cases were reported from 1 January 2012 to 30 September 2012, of which nearly 2000 cases were recorded from the Kolkata Metropolitan Corporation areas.⁴ Dengue fever and dengue haemorrhagic fever are prevalent in urban areas, as Aedes aegypti mosquito, the vector of dengue (family: Culicidae; genus: Aedes, subgenus: Stegomyia; species: Aedes aegypti), usually breeds in urban and peri-urban areas.⁵ Outbreaks of dengue fever have also been reported from rural areas of India.⁶

The rapid growth of industries and building activities, improvement of transport facilities such as railway and roads, increased movement of people from urban to rural areas, and environmental changes have all favoured the spread of dengue in rural as well as urban areas.⁷,⁸ An increase in the number
of fever cases was reported from Ramnagar-II block of Purba Medinipur district on 7 September 2012. This investigation was carried out with the following objectives: (i) to confirm the existence of an outbreak; (ii) to describe the outbreak in relation to time, place and person; (iii) to determine the etiology of the outbreak; and (iv) to recommend measures to control the outbreak.

MATERIALS AND METHODS

Ethical permission was not required for this research, since it was an outbreak investigation. The data were analysed using coded numbers instead of individual names.

Descriptive epidemiology

Health workers informed the researchers about a sudden increase of fever cases that occurred during September 2012, in four villages, namely Badalpur, Gopalpur, Ramchandrapur and Tajpur, under Ramnagar-II block of Purba Medinipur district, West Bengal. Febrile illness was associated with myalgia, arthralgia, headache, retro-orbital pain, rash and haemorrhagic manifestations suggestive of dengue fever. Dengue fever (suspected dengue case) was defined as acute febrile illness of 2–7 days’ duration, with two or more of the following: headache, retro-orbital pain, myalgia, arthralgia, rash, haemorrhagic manifestations, or leukopenia; and a confirmed case of dengue was also associated with one or more of the following: supportive serology (reciprocal haemagglutination–inhibition antibody titre, comparable immunoglobulin G (IgG) enzyme-linked immunosorbent assay (ELISA) titre, or positive monoclonal IgM antibody capture (MAC-ELISA) test in a serum specimen from the late acute or convalescent phase. Clinically suspected dengue cases were tested with a rapid test kit such as NS1 antigen (nonstructural antigen 1 rapid diagnostic) test kit. Since a dengue referral laboratory was not available at the outbreak district, blood samples were also sent to Midnapore Medical College Hospital for MAC-ELISA test, for confirmation of dengue virus. Use of the NS1 ELISA and IgM ELISA (MAC ELISA) tests was recommended by the West Bengal Government for confirmation of dengue at public health laboratories.

Data collection and analysis

Trained health workers worked with the primary investigator to collect data in a predesigned format. They conducted house-to-house surveys to identify fever cases in the affected villages and also looked for any affected patients from the four villages admitted at the Ramnagar-II Block Primary Health Centre and Contai Subdivisional Hospital. These two hospitals were the referral hospitals for these villages. The proportion of cases by age group and sex was calculated. The outbreak was described in terms of time, place and person, and an epidemic curve was drawn to observe the dynamic of the outbreak. It was recognized that the movements of villagers to the dengue-endemic area might spread the outbreak.

Entomological investigation

A demographic map of the study villages and surveyed houses was prepared. An entomological investigation was carried out to understand the density of vectors responsible for viral transmission. A larval survey was conducted by searching mosquito breeding sites inside and outside houses, using the single larval survey (SLS) technique. Larvae were identified by visual inspection of their appearance and movement in water, by the district public health specialist/epidemiologist. Analysis and calculation of the standard Aedes larval indices, such as House Index (HI), Container Index (CI) and Breteau Index (BI), were carried out, to estimate the prevalence and infestation level of vectors in the locality.

A value of HI greater than 5% and/or of BI greater than 20% for any locality are indications that the locality is prone to dengue. For epidemiological purposes, the HI indicates potential spread of virus through an area once an infected case becomes established. Lawns and grounds around the houses were considered as peri-domestic sites. Unused wells, tree holes, discarded tyres, empty coconut shells, broken earthen pots, plastic cups and packets, etc. were considered as breeding sites.

Environmental study

The investigation team observed the sanitation practices, water-collection habits, water containers for mosquito breeding, mosquito breeding sites, drainage systems and personal protection measures against mosquitoes. The environmental investigation was carried out with the help of records of temperature, rainfall and humidity, from the meteorological department.

RESULTS

The affected block is one of the coastal blocks of the district. The total population of these affected villages was 5381. They were mainly farmers and labourers by occupation and some of them moved for work to dengue-endemic areas and visit their houses frequently. A total of 100 affected patients were identified in the four villages, of which 56% (56/100) were men. There was no history of dengue cases over the previous 5 years. The highest number of affected patients was reported from the village of Gopalpur 37% (37/100), followed by Badalpur 26% (26/100), and 19% (19/100) of affected patients had a history of migration from dengue-endemic areas.

The majority of cases – 52% (52/100) – were in the age group of 15–44 years, while only 3% (3/100) of cases were aged under 5 years (see Table 1). The outbreak started on 7 September 2012, peaked on 19 September 2012 and declined gradually. There was no reported case after 28 September 2012 (see Figure 1). All 100 cases had fever. Other signs and symptoms were: myalgia (82 patients), headache (78), retro-orbital pain (73), breathlessness (47), vomiting (47), diarrhoea (17), abdominal pain (16), skin rash (14), bleeding manifestations (e.g. nose or gum bleeding, petechiae or easy bruising) (6), and altered...
cognitive function (2). Three patients had complications, of which one had multi-organ failure and two had pneumonia. All the patients recovered, except one female patient aged 43 years. The case-fatality ratio (CFR) was therefore 1%.

**Laboratory tests**

Of 100 affected patients, 79% (79/100) were positive for NS1 antigen test and 18 blood specimens were sent for MAC-ELISA test, of which 72% (13/18) were tested positive.

**Entomological survey**

A total of 989 water-holding containers from the four villages were searched for breeding sites of *Aedes* larvae, both indoors and outdoors. Of these, 208 houses in Badalpur, 468 houses in Gopalpur, 172 houses in Ramchandrapur and 289 houses in Tajpur were surveyed. An average of 8% (89/1137) of houses showed the presence of *Aedes aegypti* larvae. The average HI, CI and BI were calculated in the four villages; they were 8.0%, 13.1% and 9.5% respectively, with ranges of 2% to 13%, 2% to 23% and 2% to 18% respectively. The maximum HI, CI and BI values were observed in Gopalpur village, and were 13%, 23% and 18% (see Table 2).

**Environmental study**

During the researchers’ visit, it was observed that water accumulated in drums, drains, ponds and other containers of water. The inhabitants used to take tea in plastic and earthen pots and throw these used pots away in their yards. Water accumulated in these containers, after rain. Water also accumulated in broken flower vases, earthen pots, coconut shells and tyres, which favoured mosquito breeding. After careful examination, these coconut shells, tyres, earthen pots, flower tubs and plastic containers were found to be positive for *Aedes aegypti* larvae. There was no scarcity of water in

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**Table 1: Distribution of suspected cases of dengue fever, by age and sex, at Ramnagari-II block, Purba Medinipur district, West Bengal, India, during September 2012**

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Badalpur</th>
<th>Gopalpur</th>
<th>Ramchandrapur</th>
<th>Tajpur</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total (%)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1–4</td>
<td>1</td>
<td>1</td>
<td>2 (8)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5–14</td>
<td>2</td>
<td>0</td>
<td>2 (8)</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>15–44</td>
<td>7</td>
<td>7</td>
<td>14 (54)</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>&gt;45</td>
<td>6</td>
<td>2</td>
<td>8 (31)</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>10</td>
<td>26 (26)</td>
<td>18</td>
<td>19</td>
</tr>
</tbody>
</table>

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**Figure 1:** Epidemic curve of outbreak of suspected dengue fever at four villages of Ramnagar-II block, Purba Medinipur district, West Bengal, India during September 2012; CFR: case-fatality ratio
the villages, but water for cattle was collected and stored in earthen pots without a cover. Mosquitoes were found to be breeding there. The relative humidity and temperature of the district was 75–90% and 27–37 °C respectively, in the month of September. The total rainfall in the district during September 2012 was 302 mm.13

### DISCUSSION

This epidemiological investigation showed that the outbreak was probably dengue fever. Young and active age groups were most affected, and those with a history of migration from dengue-endemic areas. Environmental conditions and larval indices favoured an explanation of *Aedes aegypti* and dengue virus transmission.

Small water containers such as plastic tea cup, water bottles, chips packets, tyres, coconut shells, earthen pots, etc. were present in these villages, which favored mosquito breeding. Newly constructed buildings and concrete roads in the villages indicated urbanization. There was no scarcity of water in the villages, but water for cattle was collected and stored water in earthen containers without cover, and mosquitoes bred there.

The BI was less than 50% in all four villages. So, a high risk of transmission was not considered. On the other hand, the BI was <5% in three out of four villages, which was not considered a low risk of transmission. Similarly, the HI of Gopalpur village was >10%, which was considered a high risk of transmission. However the HI was not <1% in the other three villages, so this could not be considered a low risk of transmission.14

Though dengue outbreaks had previously been reported from urban areas, in the recent past outbreaks had also been reported from semi-urban and rural areas of North India,15 South India,16 Western India,17 and West Bengal,18 as well as in this outbreak.

In this study, most of the patients were men and young, in the age group of 15–45 years; this finding was similar to that of a study in Upadi district,15 but dissimilar to another study at Kanyakumari of Dharmapuri district,6 where more women and children (6–15 years) were affected.

It was also evident that movement of villagers to dengue-endemic areas had contributed to this outbreak, which was consistent with the findings of other studies.6,16

<table>
<thead>
<tr>
<th>Villages</th>
<th>House Index (%)</th>
<th>Container Index (%)</th>
<th>Breteau Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gopalpur</td>
<td>13</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>Ramchandrapur</td>
<td>9</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Badalpur</td>
<td>3</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Tajpur</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

In this study, 72% (13/18) of affected patients were positive on the MAC-ELISA test, whereas a study at two villages at Dharmapuri district revealed that 42% (13/31) and 27% (14/52) tested positive, respectively.8 Climatic factors such as temperature, humidity and rainfall would have contributed to the abundance of *Aedes* mosquitoes and virus transmission.19

The spread of dengue fever in the villages needed preventive actions. The health authority, along with local administration, took joint initiatives to increase awareness of dengue fever and its signs and symptoms, and early referral of severe cases to hospital was conducted. Vector-control measures were carried out, especially reduction of breeding sources by destroying unnecessary and discarded water containers. The communities were also taught about personal protective measures against mosquito bites. It is suggested that regular training of health workers, social workers (ICDS workers), panchayat workers, local nongovernment organization workers and other departments, on dengue and other vector-borne diseases, will reduce the incidence of outbreaks in the future.

### Limitations

A pupal index survey was not carried out and involvement of a qualified entomologist would have added value to the investigation. Larvae were identified by visual inspection alone and not confirmed by a laboratory. A dengue-referral laboratory was not available at the district and the nearest laboratory facilities (at Midnapore and the School of Tropical Medicine, Kolkata) were 150–175 km away from the place of outbreak. The logistic challenges meant that, out of 100 affected patients, the MAC-ELISA test was only done for 18.

### CONCLUSION

It was revealed from the epidemiological, entomological and serological investigations that suspected fever outbreaks were probably due to dengue virus infection. Adverse meteorological conditions and unplanned urbanization favoured the breeding of *Aedes* mosquitoes in the study villages. Involvement of government sectors and community youth groups to clean up the discarded tyres and containers in the neighbourhoods, and raise awareness among the villagers addressed the dengue outbreak.

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Contributorship: DKB conceived the study with data collection, data entry, analysis and manuscript writing; RB was involved in designing the study, with editing and critical editing; MB was involved in editing, revision and critical editing the study. All authors read and finally approved the final manuscript. DKB is the guarantor of the paper.