J Vector Borne Dis 47, September 2010, pp. 189–192

Entomological investigations during an outbreak of dengue fever in Lal Kuan town, Nainital district of Uttarakhand, India

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Key words *Aedes aegypti; Ae. albopictus*; breeding index; dengue; dengue haemorrhagic fever; larval index

Dengue is a worldwide public health problem spread through out 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[1,2]. *Aedes aegypti* Linn. (Diptera: Culicidae) is the principal vector of dengue fever and is widely prevalent in India[3]. Dengue virus has also been recently detected in *Ae. albopictus* Skuse[4], which was confined to urban areas, now has spread to rural areas and also spreading in areas which were so far free from this disease[5].

Lal Kuan is a small town with a population of 18,524 (2001 census) and surrounded by many villages situated at the foothills of sub-Himalayan Kumaon region in Nainital district of Uttarakhand state. It has irregular piped water supply resulting in water storage practices for household purposes and has a Century Pulp Paper Mill (CPPM). Migratory labour poses an increased risk of vector-borne diseases, including dengue fever and DHF in this region.

An outbreak of dengue was reported during August to September 2009. As of October 2009, a total of 1285 fever cases and 286 clinical suspected cases of dengue were admitted in different hospitals. Of which, 43 were dengue fever cases confirmed by the National Institute of Communicable Diseases, Delhi (based on serology kits for IgG and IgM antibodies). About 10 deaths were reported during the outbreak in 2009, which could not be attributed to dengue alone. Necessary efforts were taken by the district health authorities (DHA) to contain the epidemic.

At the request of the state health department, detailed entomological investigations were carried out from 27 September to 2 October 2009 in 14 randomly selected localities. A door-to-door survey was carried out in houses and peri-domestic areas to detect *Aedes* 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[6] 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 analyzed and calculated in terms of different indices like container index (CI), house index (HI), breteau index (BI), pupal index (PI) as per the WHO procedure[7].

The container preferences of *Aedes* breeding were assessed by calculation of breeding preference ratio (BPR).

A total of 418 houses were searched for *Aedes* breeding in all kinds of temporary and permanent water bodies both indoors and outdoors in all the residential and commercial areas of the town. Breeding was detected in 197 houses. About 3079 water containers were searched for *Aedes* breeding, of which 1095 were found positive for *Aedes* breeding. The over all HI, CI, BI and PI were 47.12, 45.98, 261.96 and 25.11%, respectively (Table 1).

Among all the habitats, highest positivity of *Aedes* larvae was recorded in earthen pots (25.93%) followed by plastic drums/tanks/tubs (19.36%), discarded tyres (18.81%), plastic containers (10.31%) and desert coolers (9.95%) (Table 1). In addition, breeding was also observed in daubers, overhead tanks, old discarded plastic shoes, junk materials, flower vases, cemented tanks/tubs and metal containers and curing tanks during the survey. BPR was observed to be highest in flower vases (1.62) followed by daubers (1.54), discarded tyres (1.39), plastic OHTs (1.34) and cemented tanks/tubs (1.25).

In Lal Kuan town, during the survey, different larval and adult stages of *Aedes* were recorded in all the dengue-affected localities and, breeding and average MHD of vectors were found to vary from locality-to-locality. In Delhi also, the distribution pattern of *Ae. aegypti* and disposition varied from ward-to-ward[8]. The present study results also confirm to those observed in Haldwani by Kumar *et al*[2]. The authors also reported that water containers lying indoors were the preferred breeding habitats of *Ae. aegypti* and *Ae. albopictus*[2]. Another study conducted on *Aedes* mosquitoes in Tirupur town also support the results of the present study[9]. Balakrishnan *et al*[9] observed that water containers which were kept indoors were rarely cleaned and remain undisturbed most of the time, thus, resulting in high breeding of *Aedes* mosquitoes and water storage habits were found as one of the factors responsible for high *Aedes* breeding[9].

The adult *Aedes* mosquito collections were also carried out to determine the biting activity of mosquitoes with the help of aspirators and flash-lights in the morning hours (0700–0900 hrs)[7] in 14 dengue affected localities, and identified up to species level with the help of standard identification keys[10].

Table 1. Prevalence indices of *Aedes* species in different localities of Lal Kuan town, Nainital district of Uttarakhand

Localities searched	Houses visited	Houses positive	Containers searched	Containers positive	Pupae collected	HI (%)	CI (%)	BI (%)	PI (%)
Motahaldu	39	20	457	192	16	51.28	42.01	492.30	41.02
Nagina Colony	45	21	332	147	12	46.66	44.27	326.66	26.66
Bangali Colony	38	17	192	74	8	44.73	38.54	194.73	21.05
Nai Basti	8	3	38	13	–	37.50	34.21	162.50	0
CPPM Colony	61	36	249	197	24	59.01	0.79	322.95	39.34
25 Acres Colony	21	9	68	33	5	42.85	48.52	157.14	23.80
Rajeev Nagar	16	6	63	27	3	37.50	42.85	168.75	18.75
Bindukhatta	18	3	111	33	–	16.66	29.72	183.33	0
Railway Colony	21	13	69	26	2	61.90	37.68	123.80	9.52
Sanjay Colony	18	11	84	37	3	61.11	44.04	205.55	16.66
Shramik Colony	73	33	327	182	21	45.20	55.65	249.31	28.76
Main Road	9	6	56	32	6	66.66	57.14	355.55	66.66
Hathikhana	29	11	128	35	4	37.93	27.34	120.68	13.79
Ghoranala	22	7	207	67	1	31.81	32.36	304.54	4.54
Total/Average	418	197	2381	1095	105	47.12	45.98	261.96	25.11

Table 2. Man hour density of *Ae. aegypti* and *Ae. albopictus* in Lal Kuan town, Nainital district of Uttarakhand

Localities searched	*Ae. aegypti*	*Ae. albopictus*	Ratio of *Ae. aegypti* & *Ae. albopictus*
Motahaldu	9	17	1:2
Sanjay Colony	3	5	1:1.6
Bangali Colony	8	16	1:2
Nai Basti	3	8	1:2.6
CPPM Colony	17	12	1.4:1
25 Acre Colony	21	6	1:3
Rajeev Nagar	3	3	1:3
Bindukhatta	5	7	1:2.3
Railway Colony	9	4	1.1:1
Nagina Colony	27	22	1:2.4
Shramik Colony	2	32	1:1.2
Main Road	2	0	–
Hathikhana	3	4	1:1.3
Ghoranala	0	5	–
Average MHD	8	10	

Areawise man hour density (MHD) of *Ae. aegypti* and *Ae. albopictus* mosquitoes for each locality ranged between 0–27 and 0–32, respectively (Table 2). The average MHD of *Ae. aegypti* and *Ae. albopictus* was 8 and 10.07, respectively. Since the MHD above one is the critical level, it necessitated the appropriate control measures to control the outbreak of dengue in these localities.

Though an outbreak of dengue was reported for the first time in August 2009, it was confirmed by the Department of Health Services, Govt. of Uttarakhand, in the first week of September 2009 while fever cases increased sharply from second week of September and declined rapidly by the end of September 2009. All entomological indices were above the critical level and potential cause of this seems to be the compulsion of storing water in different containers without cover, to meet the acute shortage of water in the area. Since most people work as labourers in the CPPM, they might not be aware of the conditions or factors that can exacerbate mosquito breeding.

Aedes breeding indices and adult densities have been recorded above the critical levels imply their potential for future outbreaks. This is mainly attributed to change in ecology, cultural and social behaviour of population, life style changes, non-availability of tap water supply enforcing water storage in containers etc. The reporting of dengue and high density of dengue vectors might be due to rise in temperature making it favourable for transmission of dengue. Therefore, in order to contain the occurrence of DHF/DF, entomological surveillance should be undertaken effectively in the known endemic localities and the information should be utilized to forecast the possibility of future outbreaks of DHF/DF, so that necessary control measures could be undertaken to avoid any dengue outbreak in future. Introduction of dengue virus in the Lal Kuan community might be due to influence of internal migratory labour working in the CPPM industry from the adjoining city of Haldwani. In the recent past, Haldwani has experienced/recorded an outbreak of dengue in 2007.

From the present investigations, it can be concluded that *Aedes* larval and adult stages were detected in the transmission season in Lal Kuan town, Nainital district with most of the areas showing high adult and larval indices, which are probabaly the reasons for sudden spurt of dengue fever cases. The preventive strategy needs to be directed towards minimizing the breeding potential of *Aedes* by adopting one/two days bottom up programme every week, and water management practices by individuals along with implementation of urban bye-laws as well as special IEC activities. Further study is warranted to elucidate the reason for development of foci of dengue in Lal Kuan town which was hitherto free from dengue and for further prevention of occurrence of epidemics.

Acknowledgement

The authors are thankful to the technical staff of NIMR, Shri Harikesh Gupta and Shri N. Keshav Rao, for their active involvement and assistance during the field survey.

References

1. Sharma SN, Raina VK, Kumar A. Dengue/DHF an emerging disease in India. *J Commun Dis* 2000; *32*(3): 175–9.
2. Kumar S, Singh US, Katyal R. Preliminary observation on *Aedes aegypti* survey during lean transmission season in sub-Himalayan town of India. *J Commun Dis* 2008; *40*(4): 167–8.
3. Kalra NL, Kaul SM, Rastogi RM. Prevalence of *Aedes aegypti* and *Aedes albopictus* vectors of DF/DHF in north, north-east and central India. *Dengue Bull* 1997; *21:* 84–92.
4. Yadav RL, Narasimham MVVL. Dengue/dengue haemorrhagic fever and its control in India. *Dengue Newslett* 1992; *17:* 3–8.
5. Kumar A, Sharma SK, Padbidri VS, Takare JP, Jain DC, Datta KK. An outbreak of dengue fever in rural areas of northern India. *J Commun Dis* 2001; *33*(4): 274–81.
6. *Guidelines for dengue surveillance and mosquito control,* II edn. Manila, Philippines: WHO Regional Office of the Western Pacific 2003; p. 105.
7. *Manual on practical entomology in malaria*. Pt II. *Methods and Techniques*. Geneva: World Health Organization 1975; p. 1–3.
8. Nandi J, Sharma RS, Datta PK, Dhillon GPS. Dengue in the National Capital Territory (NCT) of Delhi (India): epidemiological and entomological profile for the period 2003–2008. *Dengue Bull* 2008; *32:* 156–61.
9. Balakrishnan N, Venkatesh S, Lal S. An entomological study on the dengue vectors during outbreak of dengue in Tiruppur town and its surrounding, Tamil Nadu, India. *J Commun Dis* 2006; *38:* 164–8.
10. Das BP, Kaul SM. Pictorial key to the common Indian species of *Aedes (Stegomyia)* mosquitoes. *J Commun Dis,* 1998; *30:* 123–7.

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Received: 12 April 2010 *Accepted in revised form:* 8 July 2010