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Prevalence of *Aedes* mosquitoes in various localities of Delhi during dengue transmission season

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ABSTRACT

Entomological investigations were carried out in various localities of different Municipal Zones of Delhi, India, from July to November 2012 with a view to study the prevalence, distribution and stratification of areas for Aedes species and to identify high risk areas in the town prone to dengue/ DHF outbreak. A total of 1050 houses including some outdoor habitats were searched for Aedes breeding. Of the total houses surveyed, Aedes breeding could be detected in domestic containers/drums, water storage tanks in 276 houses. In all, a total of 8972 water containers were searched, out of which 1893 were found positive for Aedes breeding. The overall house index (HI), container index (CI), breteau index (BI), and pupal index (PI) were 26.28, 21.09, 180.28 and 67.33 respectively. Aedes aegypti was the predominant species in intra-domestic and peri-domestic containers, while Aedes albopictus and Aedes vittatus larvae were also observed in outdoor habitats. Aedes aegypti breeding was detected in all the localities, where dengue cases were recorded during the past 3 years. Based on the various indices, Aedes aegypti population was most prevalent in Sangam Vihar locality in MCD south Zone, irrespective to the number of dengue cases.

Key words: Dengue fever, *Aedes* breeding, house index, container index, breteau index, pupal index, Delhi

INTRODUCTION

Dengue is a worldwide serious public health problem spread throughout the tropical and subtropical zones. It is endemic in South-East Asia, the Pacific, East and West Africa, the Caribbean and the Americas [1]. Dengue fever (DF), the most common arboviral disease is caused by four strains of dengue virus (DEN1, DEN2, DEN3 and DEN4) a member of flavivirus group in the family-flaviviridae and transmitted by female *Aedes aegypti* mosquito [2]. In India, DF and Dengue hemorrhagic fever (DHF) are emerging fast as a major health problem [3]. A total of 75454 dengue cases with 167 deaths were reported in 2013 by the National Vector Borne Disease Control Programme (NVBDCP) from all parts of the country including union territory [4]. The increasing trend of dengue outbreaks accompanied by DHF is posing a problem of utmost importance to the public health of the country during the past 60 years [5].

The first outbreak of dengue fever in India with hemorrhagic manifestations was reported in 1963 [6]. Delhi is endemic for DF/DHF and has experienced several outbreaks of DF/DHF since 1967[7]. In the recent past, a severe outbreak of DF/DHF was recorded in 1996 which was most severe and resulted in more than 10252 hospitalizations and 423 deaths. Kaul et al.1998 reported that all the four dengue serotypes (DEV 1-4) are circulating in the country [8].

Vector surveillance is an important tool to generate entomological data needed for control strategies [9]. Various studies have been carried out on comprehensive surveys of the *Ae. aegypti* breeding in Delhi and its importance as

the dengue fever vector [10-15]. Dengue virus has also been recently detected in *Aedes albopictus*, a secondary vector of dengue [16]. Now this vector has spread to rural areas also and spreading in areas which were so far free from this disease due to increasing urban population, unplanned urbanization, rapid transportation (movement of human carriers and infected mosquitoes), unreliable water supply and storage practices[17-20]. The present study was carried out in various dengue affected localities in different municipal Zones of Delhi to study the prevalence, distribution and stratification of areas for *Aedes* species and to find the preferred breeding habitats in these areas and also to identify high risk areas in the town prone to dengue/ DHF outbreak. The results of the study are presented in this communication.

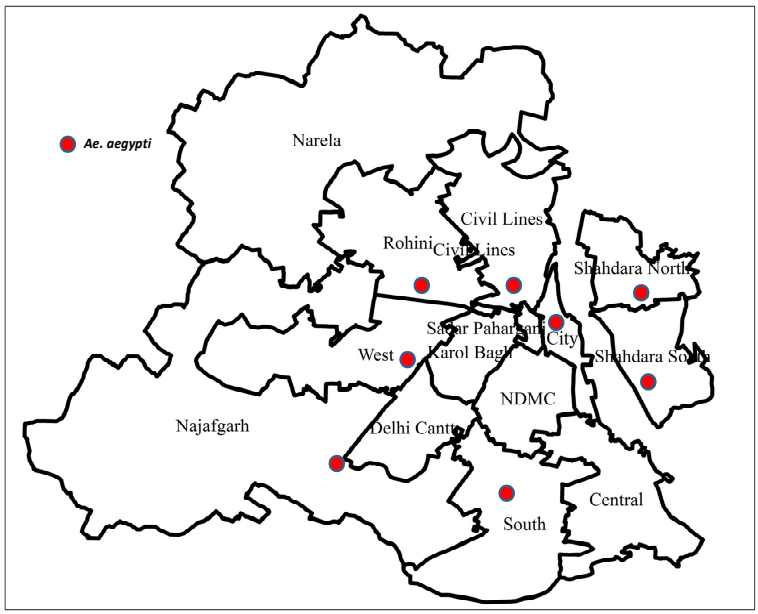
MATERIALS AND METHODS:

Location & Geography of study area:

Delhi, also known as the National Capital Territory of India (NCT) is a metropolitan region in India. It has a population of nearly 25 million as of 2014 and 2nd most populous city with an area of 1485 sq.km, is located on both side of Arawali hill's range in the heart of the Indian sub-continent. It is surrounded on three sides by Haryana and to the east, across the river Yamuna by Uttar Pradesh. The altitude of Delhi range between 213-305 meters above the sea level and it is located at 28.61^{O} North latitude and 77.23^{O} East longitude on the intersection topography. It can be divided into three segments- the Yamuna flood plain, the Ridge and the plain. The ridge constitutes the most dominating physiographic features of this territory. It originates from the Arawali hills of Rajasthan and entering the union territory from the south extends in a north eastern direction. The Ridge and nearby areas are the natural habitat of monkeys. It encircles the city on the northwest and west. The average annual rainfall is 714 mm and annual temperature range between 2^{O}C-45^{O}C respectively.

The NCT of Delhi has multiple agencies responsible for the control of vector-borne diseases as Municipal Corporation of Delhi (MCD), New Delhi Municipal Council (NDMC) and Delhi cantonment Board (DCB). MCD is administratively divided in to 12 zones and 272 wards. Entomological surveys were carried out in various affected localities of 8 MCD Zones on the bases of incidences of dengue cases.

Fig. 1: Map of Delhi showing study sites



Entomological survey:
The survey was carried out in selected 21 localities in the houses and peri-domestic areas to detect *Aedes* breeding during July to November 2012 as shown in table 1. A total of 50 houses in each locality were visited on the basis of dengue fever cases reported, and larval collections were made to find out the *Aedes* breeding in all the wet containers present in and around the houses. All localities were selected based on confirmed cases reported during the previous three years. The larval collections were made simultaneously in each locality following the single larval technique [21-22]. We also surveyed the Ridge area, gardens and parks. All kinds of breeding habitats in the study area like cemented tubs/tanks, overhead tanks, iron/metal drums, junk materials, desert cooler, discarded tyres etc. were screened for the presence of immature stages of *Aedes* mosquitoes and identified up to species level with the help of standard identification keys [23]. All the water containers were searched with the help of flash light and pipette, while bigger containers were searched with the help of dipper of 300 ml capacity (having white background for better visibility). The type of breeding habitats and their location 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(B1), pupal index(PI) as per the procedure of WHO[22,24].

RESULTS

A total of 1050 houses were searched for *Aedes* breeding in all kinds of containers both indoors and outdoors in all the residential areas. Breeding could be detected in 276 houses. About 8972 water containers were searched for *Aedes* breeding, out of which 1893 were found positive for *Aedes* breeding. The overall house index (HI), container index (CI), breteau index (BI), and pupal index (PI) were 26.28, 21.09, 180.28 and 67.33 respectively (Table-1). *Aedes* larvae were recorded in all the dengue affected localities and breeding was found to vary from locality to locality, irrespective to the number of dengue cases recorded during the past three years in these localities.

The distribution of *Aedes* larvae and breeding preference ratio (BPR) in different type of breeding habitats is given in Table-2. Among all the habitats, highest positivity of *Aedes aegypti* larvae was recorded in Plastic tub/drum/tanks/ cemented OHTs (32.91) followed by broken glass wares (25.25), desert coolers (10.72), Junk materials (5.81) and pools/fountains/pits (4.64) respectively (Table-2). In addition, breeding of *Aedes albopictus* was also observed in ground level cemented tanks, cement tank in construction sites, curing tanks and Rock pits in ridge area during survey. Cement tanks in construction site in mandoli locality in Shahdara North zone (3.31) and Bird feeding earthen pots in different localities (2.73) were the most preferred outdoor habitats for breeding of *Aedes* larvae mainly due to breeding of *Aedes albopictus* and *Aedes vittatus*.

DISCUSSION

Three species of *Aedes* viz. *Aedes aegypti*, *Ae. albopictus* and *Ae. vittatus* were found in study area during the survey of which only *Ae. aegypti* was the dominant species prevalent in the domestic and peridomestic container habitats, as reported earlier also [12, 25]. In our study, *Ae. albopictus* was recorded in manmade habitats mostly found in parks, play ground, left open space nearby houses and construction sites of study area. *Ae. albopictus* and *Ae. aegypti* were also found to co-breed in same type of breeding habitat in several localities of Delhi.

In addition, mixed breeding of *Ae. aegypti*, *Ae. albopictus* and *Ae. vittatus* was also recorded in some manmade habitats in the few localities of Delhi [26]. This may be due to very fast urbanization in the last four decades and the concomitant destruction of natural habitat conditions that has forced *Ae. albopictus* and *Ae. vittatus* to adapt to breeding in manmade habitats besides restriction of natural habitats. Similar observations on adaptation of both species were recorded in Malaysia [27]. There may be intra-species competition for food and shelter, which increases its epidemiological potential and risk to public health. Pant et al. (1973) reported that *Ae. albopictus* are more likely to feed outdoor as compared with *Ae. aegypti* [9]. *Ae. albopictus* may play the role in maintenance of vertical transmission or as an amplifier in dengue transmission and could be just like a bridge of a putative sylvatic transmission from monkeys to man acting as a reservoir of dengue virus. The spread of both *Aedes* species in Delhi should be checked before the transmission season and more attention be paid to clarify the involvement of *Ae. albopictus* in the transmission dynamics of dengue in study area.

Table-1, Prevalence indices of *Aedes* in different localities of Delhi

Localities searched	Zones of MCD	Houses visited	Houses positive	Containers searched	Containers positive	Pupae collected	HI (%)	CI (%)	BI (%)	PI (%)
Majnu ka tila	Civil line	50	18	432	69	27	36.00	15.97	138	54
Rajpur Road		50	15	188	37	36	30.72	19.68	74	72
Sant Nagar		50	9	448	62	6	18.00	13.83	124	12
Nand Nagari	Shahdara North	50	16	761	113	14	32.00	14.84	226	28
Yamuna Vihar		50	13	337	57	8	26.00	16.91	114	16
Central Jail Mandoli		50	21	453	63	28	42.00	13.90	126	56
Shastri Park		50	7	444	30	42	14.00	6.75	60	84
Sonia Vihar		50	12	652	96	41	24.00	14.72	192	82
Dilshad Garden		50	7	358	45	16	14.00	12.56	90	90
Raghuveer Nagar	West	50	8	323	61	33	16.00	18.88	122	66
Paschim Vihar		50	6	421	42	46	12.00	9.97	84	92
Nagloi		50	16	476	146	23	32.00	30.67	292	46
Uttam Nagar		50	21	622	246	64	42.00	39.54	492	128
Sangam Vihar	South	50	26	1202	274	77	52.00	22.79	548	154
Mayur Vihar II	Shahdara South	50	11	310	48	43	22.00	15.48	96	86
Tilak Bridge	City	50	8	298	56	8	16.00	18.79	112	16
Mangol puri	Rohini	50	19	509	217	67	38.00	42.63	434	134
Pitampura		50	10	199	38	33	20.00	19.09	76	66
Vasant Kunj	Nazafgarh	50	14	206	99	15	28.00	48.05	198	30
Aaya Nagar		50	7	177	19	51	14.00	10.73	38	102
Nagal Dewat		50	12	156	75	29	24.00	48.07	150	58
Total		1050	276	8972	1893	707	26.28	21.09	180.28	67.33

Table-2 Breeding Preference Ratio (BPR) of *Aedes* in different habitats

Type of breeding habitats	Number of containers with water				Breeding Preferences Ratio
	Examined	(X %)	With *Aedes* larvae	(Y %)	BPR (Y/X)
Desert coolers in houses	1659	18.49	203	10.72	0.57
Flower pots in houses	256	2.85	32	1.69	0.59
Earthen pots in houses	302	3.36	49	2.58	0.76
Ground level cemented tanks	172	1.91	76	4.01	2.09
Pools/fountains/pits in Parks	287	3.19	88	4.64	1.45
Discarded tyres in open spaces	188	2.09	83	4.38	2.09
Broken glass wares in open	1958	21.82	478	25.25	1.15
Plastic tub/drum/tanks/OHTs	3302	36.80	623	32.91	0.89
Iron drums/tubs/tanks	124	1.38	22	1.16	0.84
(Cement tank) constricted sites	78	0.86	54	2.85	3.31
Bird feeding earthen pots	99	1.10	57	3.01	2.73
Junk materials in open space	455	5.07	110	5.81	1.14
Rock pits in ridge area	92	1.02	18	0.95	0.93
Total	8972		1893		

Trans-ovarian cycle of dengue virus in *Ae. albopictus* reared from viable eggs retrieved from the soil of tree holes has been reported [28-29]. Tewari et al reported natural infections of dengue virus in *Ae. albopictus* reared from Aedes larvae collected from tree holes in south India [30]. Recently Kumari et al. 2011 found natural infections in *Ae. albopictus* in Delhi [26].

In our study, high entomological indices in some localities above the critical level and potential cause of this seems to be the compulsion of storing water in different containers to meet the acute shortage of water. Most of the people may not be aware of the factors exacerbating mosquitoes breeding conditions, as larval breeding indices have been recorded above the critical levels suggesting its potential for future outbreaks. This is mainly attributed to change in ecology, cultural and social behavior of population, living of lifestyle changes, non-availability of tap water supply enforcing water storage in containers etc. Therefore in order to contain the repeated occurrence of DHF/Dengue cases, 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/Dengue so that necessary control measures could be in place before possible Dengue outbreaks. It can be concluded that *Aedes* breeding detected in the transmission season in Delhi, with most of the areas showing high larval indices may be the probable reason for persistence of dengue. The preventive strategy needs to be directed towards minimizing the breeding potential of *Aedes* by adopting bottom up programme, water management practice by individuals along with implementation of urban bye-laws as well as IEC activities are suggested to contain epidemics in future, which was hitherto free, for further containment.

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