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ABUNDANCE AND LARVAL INDICES OF DENGUE VECTOR *AEDES AEGYPTI* AND *AE. ALBOPICTUS* AND RISK FOR DENGUE VIRUS TRANSMISSION IN DEHRADUN DISTRICT, UTTARAKHAND.

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Abstract;
Mosquito-borne disease, especially malaria and Dengue fever causes serious public health problems in district Dehradun, one of the most populous city of Uttarakhand states after Haridwar. *Aedes aegypti* mosquitoes act as the major vector of Dengue fever in this city. The present study on prevalence of dengue in Dehradun city was undertaken between January 2015 and December 2016 to assess the distribution pattern of dengue vectors and their seasonal variations. Indoor resting mosquitoes were collected from four selected localities by aspirator and torch light in morning hours (06:00-08:00hr). A total of 971 houses were searched during house to house larval and adult survey. *Aedes* breeding could be detected in 226 houses. In all, a total of 684 domestic water containers were searched, out of which 93 were found positive. The overall house index (HI), container index (CI). Breteau index (BI) and pupal index (PI) were 23.27%, 13.60%, 9.58% and 5.87% respectively. The study revealed that *Aedes aegypti* and *Aedes albopictus* are well established in Dehradun city with most of the areas showing high adult and larval indices.

Key word; Dengue, *Aedes*, Dehradun. Transmission, Indices

Introduction

Dengue is a mosquito-borne viral disease of global health concern. Dengue fever (DF) and Dengue haemorrhagic fever (DHF) are re-emerging fast as a major public health problem (Sharma et al., 2000). The epidemics of the disease are very fast and some time claims heavy toll of human life. WHO has recently categorized DHF as number one emerging and uncontrolled disease. In India many outbreaks have been reported from many parts of the country particularly from rural areas (Kaul et al., 1998). The role of *Aedes* mosquitoes in the spread of many arboviral infections including dengue and Chikungunya is now well documented (Tyagi and Das, 2006 and Thenmozhi et al., 2007). *Aedes aegypti* Linnaeus

play a key role in transmission of dengue in various states of India as this vector is widely present in India. Recently, dengue and chikungunya virus has also been detected in *Aedes albopictus* Skuse (WHO, 2006). The increase of dengue cases in this region is due to such factors as rapid population growth, expanding unplanned urbanization, inadequate water supply and difficulties in refuse disposal. These have led to an abundance of new mosquito- breeding sites especially for the urban vector of mosquito, *Ae. aegypti*.

As far as the availability of *Aedes* species from Dehradun district is concerned, only *Aedes albopictus* was recorded in the past (Wattal et al., 1958 and Bhat, H.R., 1975). Dengue has so far not been reported in Distt Dehradun till the year 2003. Pemola and Jauhari (2004 and 2008) reported first time the existence of *Aedes aegypti* in Garhwal region including Distt Dehradun. During an outbreak in 2010, 2889 cases of dengue were reported from this district including 4 deaths.

Materials and methods

Study areas: the study was carried out in Dehradun city where an outbreak of Dengue took place in the year 2010. The city is being developed in an unplanned way after the deceleration of state capital of Uttarakhand in 2000. As a consequence of urbanization, high population density, crammed living condition and inadequate sanitary facilities lead to a highly polluted environment. This environment is highly conductive to the proliferation and spread and promotes infestation by mosquitoes and other pests. Moreover, due to shortage of pipe water facilities, the people of all walks of life store in big containers. Socio-economic factors have changed the feeding habits of the city dwellers and as such more containers of different kinds are used and carelessly discarded hither and hither resulting an increase of breeding places for dengue mosquitoes.

Study was conducted from January to December 2012 in four areas of Dehradun city viz., Doiwala, Sahaspur, Raipur and ISBT locality, that were selected randomly covering all directions and all socio-economic groups. Every fourth houses in each area was searched for water holding containers and presence of *Aedes* larvae in those using flashlight. All kinds of breeding habitats in the study areas like unused wells, tree holes, drums, tubs, tanks, overhead tanks, iron/metal drums, empty battery box, junk materials, desert coolers, discarded tyres, curing tanks, etc, were screened for the presence of immature stages of *Aedes* mosquitoes. Larvae from these containers were collected and reared up separately to adult stage to identify the species and its breeding preferences. The data on larval survey were analysed and calculated in terms of different indices like House index (HI), Container

index (CI) Breteau index (BI) and pupal index (PI) as per the WHO (2003) guidelines. The present study used the following formulae to calculate HI, CI and BI.

House Index (HI) : Percentage of houses infected with larvae/or pupae

$$HI = \frac{\text{Number of houses inspected}}{\text{Number of houses inspected}} \times 100$$

Container index (CI): Percentage of wet containers infested with larvae and /or pupae.

$$CI = \frac{\text{Number of positive containers}}{\text{Number of wet container inspected}} \times 100$$

Breteau index (BI): Number of positive containers per 100 houses inspected

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

Adult collection:

Adult *Aedes* mosquitoes were collected with the help of aspirators and flashlights during morning hours (0700-0900) from tyres, cement tanks, iron pipes, etc. and identified up to species level with the help of standard identification keys (Das and Kaul, 1998) and per man hour density(PMHD) was also calculated for each locality.

Results and discussion

In all, 971 household were surveyed in different months and 684 water holding containers were checked. Overall HI, CI, BI and PI were 23.27, 13.66, 9.58 and 5.87 respectively which varied from month to month. Overall *Aedes aegypti* infestations were higher than threshold level of ≥ 5% of HI and below threshold level of BI(>20%).

Area -wise house, container and Breteau index: Prevalence of Aedes species was not uniform in all the areas. All the indices were significantly higher in Doiwala area compared to other three areas and lowest in Sahas pur locality (Table 1). Overall PI was below threshold level while HI was above the threshold level in all areas.

Month wise prevalence of *Aedes aegypti*: Overall Breteau index, container index and House index showed typical seasonal trend with its peak during September-October and gradual decline till March and thereafter again in Monsoon months (Table 2).

Aedes aegypti breeding habitat: Discarded tyre, cement tank, underground tank, cement cistern and ceramic drum were observed to be the major breeding sites for *Ae. aegypti*,

mud pot, metal drum and plastic containers also contribute significantly as breeding sites. During summer (may- June), coolers were also found having *Aedes* larvae. Among infested containers, mud pots constitute 38% followed by discarded tyres, cement tanks and cement cisterns.

Species composition: a total of 885 specimens of Aedes genera were emerged, Ae. aegypti was the commonest species (91.41%) followed by Ae. albopictus and Ae. vittatus (table 3).

Indoor resting density: limited efforts were made to collect adult *Aedes* mosquito to determine man -hour density and species composition. Overall man hour density of *Ae. aegypti* and *Ae. albopictus* was 6.81 and 1.08 respectively. *Aedes aegypti* constituted 86.27% of *Aedes* genera. Species composition of resting adults was similar to the composition of laboratory emerged adults. (Table 4)

Observation in Dehradun city area showed the occurrence of *Aedes* indicating possibilities for future outbreaks of Dengue fever. City areas has irregular piped water supply resulting in water storage for domestic use. The entomological indices HI, CI and BI for *Aedes aegypti* increases from April to October, and thereafter declined. CI, BI, and HI remained very high during months of September and October. The rise in breeding indices during the post monsoon season was due to the increased number of potential breeding sites due to the rains in the preceding months. Dewan Chand et al (1961), Krishna Marthy et al (1965) and Katyal et al (1996) also reported higher densities of *Aedes aegypti* in the month of October corresponding to the monsoon months in Delhi. Singh et al., (2011) while studying the prevalence of *Aedes* at Koderma,

Jharkhand found that containers, houses, Breteau and pupal index were higher than normally acceptable limits and *Aedes* breeding was recorded in all the localities of the study area and found to vary from locality to locality. In Dehradun, during the survey, different larval and adult stages of *Aedes* were recorded in all the 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 (Nandi et al. 2008). The present study results also confirm to those observed in Haldwani by Kumar et al (2008), in Ranchi by Singh et al (2008) and in Lal Kuan town Nainital district by Singh et al (2010). Another study conducted on Aedes mosquitoes in Tirupur town also support the result of the present study (Balakrishanan et al., 2006).

From the present entomological investigation, it can be concluded that *Ae. aegypti* is well established within the urban agglomeration of Dehradun city, with most of the areas

showing high adult and larval indices which may be the probable reason for sudden spurt of dengue in this area.

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.

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Table 1 : Prevalence indices of *Aedes* in different localities of Dehradun City.

Searched Area	Houses visited	Houses positive	Container searched	Container positive	Pupae collected	HI (%)	CI (%)	BI (%)	PI (%)
Sahaspur	240	46	563	15	12	19.16	9.80	6.25	5.00
Doiwal	270	82	185	31	18	3037	16.75	11.48	6.67
Raipur	235	52	186	22	15	2.12	11.82	9.36	6.38
ISBT	226	448	160	25	12	21.24	15.63	11.06	5.31
Total	971	226	684	93	57	23.27	13.60	9.58	5.87

Table 2 Prevalence indices of *Aedes* in different localities of Dehradun city

Months	Houses Checked	Houses positive	Container searched	Container positive	Pupae collected	HI	CI	BI	PI
Jan.	25	-	12	-	-	4.00	8.33	4.00	4.00
Feb.	32	2	23	1	-	6.25	4.35	3.13	3.13
Mar.	65	4	45	4	2	6.15	8.89	6.15	3.08
Apr.	53.9	9	42	3	2	16.67	7.14	5.66	3.78
May	87	12	58	7	6	13.79	12.07	8.05	6.90
Jun.	90	23	78	12	4	25.56	15.38	13.33	4.44
Jul.	112	34	96	9	8	30.36	9.38	8.04	7.14
Aug.	143	43	102	11	10	30.07	10.78	7.70	6.99
Sep.	134	46	123	25	12	41.79	20.33	18.66	8.96
Oct.	120	28	71	12	9	23.33	16.90	10.00	7.50
Nov.	76	12	22	8	4	15.79	36.36	10.53	5.26
Dec.	34	3	12	1	-	8.82	8.33	2.94	2.94

Total	971	226	684	93	57	23.27	13.60	9.58	5.87

Table 3 : Species composition of *Aedes* mosquitoes

Months	***Ae.aegypti***		***Ae. albopictus***		***Ae. vitattus***		**Total**	***% Ae. aegypti***
	Male	**Female**	**Male**	**Female**	**Male**	**Female**		
Jan	0	0	0	0	0	0	0	-
Feb	2	3	0	0	0	0	5	100.0
Mar	12	14	0	0	0	0	26	100.0
Apr	20	24	0	0	0	0	44	98.36
May	28	32	0	1	0	0	61	90.22
Jun	34	49	4	5	0	0	92	90.22
Jul.	53	65	1	2	0	0	121	97.52
Aug	57	64	6	5	2	0	134	90.29
Sep	60	75	3	5	1	0	144	93.75
Oct	91	110	10	14	6	10	241	83.42
Nov	4	8	0	0	0	1	13	92.30
Dec	1	3	0	0	0	0	4	100.0
Total	362	447	24	32	9	11	885	91.41

Table 4 : Man Hour Density of *Aedes* mosquitoes in Dehradun city

Months	***Ae. aegypti*** **(N)**	***Ae. aegypti*** **(MHD)**	***Ae. albopictus*** **(N)**	***Ae. albopictus*** **(MHD**

Jan	0	0	0	0
Feb	2	0.50	0	0
Mar	4	1.00	1	0.25
Apr	12	3.00	0	0
May	20	5.00	3	0.75
Jun	27	6.75	3	0.75
Jul.	32	8.00	6	1.50
Aug	42	10.50	6	1.50
Sep	42	10.50	6	1.50
Oct	64	13.50	10	2.50
Nov	6	1.50	2	0.50
Dec	0	0	0	0
Total	245	6.81	39	1.08