J Vector Borne Dis 48, March 2011, pp. 58–60

Short Research Communications

Breeding propensity of *Anopheles stephensi* in chlorinated and rainwater containers in Kolkata City, India

Bithika Mandal[1], Baishakhi Biswas[1], A. Banerjee[1], T.K. Mukherjee[1], J. Nandi[2] & D. Biswas[1]

[1]*Vector Control Department, Kolkata Municipal Corporation, Kolkata;* [2]*Directorate of National Vector Borne Disease Control Programme, Delhi, India*

Key words *Anopheles stephensi*; chlorinated water; container index; Kolkata Municipal Corporation; malaria; rainwater

Anopheles stephensi (Diptera: Culicidae) remains the long-incriminated prime vector of malaria in the city of Kolkata[1,2] and it spreads the disease throughout the year. Unfortunately, precise information regarding its breeding habits is abysmally lacking. Hence, a year-long (July 2009–June 2010) study was conducted to throw light on this issue.

All sorts of open water storage containers/sites, including some wells, in and around a total of 1000–1100 human dwellings in 25–30 highly malarious wards of the city were checked for mosquito larvae once a month from July 2009 to June 2010. For collecting mosquito larvae, two of the World Health Organization-approved methods, viz. dipping and pipetting, were followed[3]. Up to 10 mosquito larvae from every breeding site[4] were collected and brought to laboratory for identification[5]. Sometimes the collected larvae were reared in mosquito cages till the emergence of adults. The adults emerged were identified on the basis of their external morphology using the appropriate taxonomic keys[6]. Type and number of both chlorinated and rainwater containers searched and those found positive for *An. stephensi* larvae were recorded. Monthly reports concerning rainfall in Kolkata were obtained from the Alipore Meteorological Office, Govt. of India.

Altogether, 24,023 water containers (3805 rainwater and 20,218 chlorinated water containers) were searched, of which 524 (2.2%) were positive for the larvae of *An. stephensi.* Among the rainwater and chlorinated water containers checked 6.1% (232/3805) and 1.4% (292/20,218) respectively proved positive for the larvae of this species.

Among the rainwater containers/sites, rainwater collections in water tanks (built for soaking bricks and other construction purposes) containing *An. stephensi* larvae to the extent of 27.1% (82 out of 303 tanks checked) seemed to be the most preferred breeding sites of the vector species. Relative distribution of other categories of rainwater containers with *An. stephensi* larvae in descending order was: uncovered overhead water tanks 24.4% (22 out of 90 tanks searched), accumulated rainwater on rooftops 21.2% (87 out of 410 rooftops checked), low-lying lands 4.7% (29 out of 619 lands searched), masonry tanks 3.1% (2 out of 65 tanks examined), and miscellaneous containers including battery shells, tin cans, bitumen drums and tyres 0.4% (10 out of 2318 articles searched). As a whole, the larval density of *An. stephens*i in rainwater containers, expressed as the average number of larvae per dip per positive container, varied from 2 to 9, while in chlorinated water containers the variation with regard to the larval density was from 1 to 3.

Like rainwater containers, chlorinated water containers too showed a distinct variation with regard to their conduciveness to the breeding of *An. stephensi* and their relative distribution was: water tanks at construction sites 3.4% (169 out of 4980 tanks checked) followed by overhead tanks 2.4% (111 out of 4626 tanks searched), rooftops with seepage water 1.3% (3 out of 236 sites examined), basement water tanks 0.8% (1 out of 121 tanks searched), masonry tanks (commonly called *chowbachchas*) 0.2 % (5 out of 2998 tanks checked), and miscellaneous containers including various small plastic, tin and iron containers 0.04% (3 out of 7257 containers searched).

Variation in the percentage of rainwater containers with *An. stephensi* larvae was from 0 in December 2009–May 2010 with maximum 11.1 in November 2009, whereas the percentage positive for chlorinated water containers varied from 0.4 in December 2009 to 2.3 in May 2010 with a maximum of 2.8 in September 2009.

The season-wise break-up for rainwater containers with *An. stephensi* larvae was: 5.9% (204 out of 3434 containers) in rainy season, 10.9% (16 out of 147 containers) in winter season, and 5.4% (12 out of 224 containers) in summer season. The corresponding figures for chlorinated water containers were 1.5% (94 out of 6195

containers), 0.7% (40 out of 5624 containers) and 1.9% (158 out of 8399 containers) respectively.

The number of malaria cases reported in 136 clinics of Kolkata City during July 2009 to June 2010 are presented in Table 1. The results clearly show that the number of malaria cases detected in September was the highest and the number of cases detected in January was the lowest.The incidence of malaria started increasing from April and reached its highest peak in September.

The variation in the figures of container index (CI) of *An. stephensi* was from 0.4% in December (5 out of 1210 containers checked) to 4.4% in October (84 out of 1912 containers checked). In the months of September and October, when cases of malaria were detected in greater numbers, percentages of water containers with *An. stephensi* larvae too were very high as compared to those in the rest of the year (i.e. 4.3% in September and 4.4% in October), thereby clearly demonstrating a positive correlation between the incidence of malaria and the CI of the vector species. Incidentally, the lowest CI of the species (i.e. 0.4%) was noticed in December, just one month before the detection of the lowest number of malaria cases. Interestingly, in December–May, when there was practically no or very little rainfall in the city, *An. stephensi* larvae were found exclusively in chlorinated water containers, thereby implying that for its survival in dry seasons, the vector chose chlorinated water containers for its procreation. Detection of the lesser number of chlorinated water containers with *An. stephensi* larvae during the winter was quite indicative of the ill effect of the lowest temperature on its breeding.

Table 1. Malaria cases reported in 136 clinics of Kolkata City during July 2009 to June 2010

Month	No. of malaria cases	Percent
Jul 2009	6,663	7.2
Aug	15,156	16.5
Sep	22,035	24.1
Oct	18,554	20.2
Nov	10,732	11.7
Dec	3,675	4
Jan 2010	935	1
Feb	1,440	1.6
Mar	1,630	1.8
Apr	2,946	3.2
May	3,962	4.3
Jun	4,090	4.4
Total	91,818	100

As revealed by the study, rainwater was more conducive to the breeding of *An. stephensi* than chlorinated water. With the onset of rain in late June or early July, the number of rainwater containers increased rapidly, as a result of which *An. stephensi* got a greater scope of breeding and that triggered a higher transmission of malaria in the metropolis with a peak reaching in September.

Pertinently, many people in Kolkata store rainwater in various containers for domestic use. Some people even keep their overhead water tanks open for rainwater to accumulate therein. This practice made the water tanks turn into favourable breeding sites of *An. stephensi*. *Anopheles stephensi* larvae in Chennai City are commonly found in overhead water tanks, underground water tanks, cisterns and wells. Besides above sites, rainwater harvesting wells and other places in Chennai City too support extensive breeding of some vector species, including that of *An. stephensi*[7]. Earlier, breeding habit of this species was detected in wells, cisterns, roof-gutters, fountain basins, garden tanks, tubs, discarded tins and other receptacles in urban areas[8]. Surprisingly, in Kolkata, no larvae of *An. stephensi* were detected in wells in the present study. However, the types of breeding sites of *An. stephensi* detected in Kolkata closely resembled those in Chennai City barring the wells.

Finally, the information obtained from the study suggests that during rainy season, water holding sites/containers in and around human-dwellings, more particularly those specified herein, have to be checked properly for the larvae of *An. stephensi*, apart from requesting the city-dwellers to take proper care of their *chowbachchas*, underground water reservoirs, overhead water tanks, water collections in under-construction buildings and other construction sites to prevent breeding of the vector species, especially during the pre-monsoon and the dry winter months. Thus, the information will help plan control strategies against the vector species needed for effective control and prevention of malaria in Kolkata.

ACKNOWLEDGEMENTS

The authors duly acknowledge with thanks the encouragement given by Shri Atin Ghosh, Hon'ble Member, Mayor-in-Council (Health) of Kolkata Municipal Corporation for conducting the study. The authors are also grateful to the cooperation extended by the Integrated Disease Surveillance Programme (IDSP) wing of KMC for providing epidemiological data on malaria. The authors thankfully acknowledge the assistance given by all the vector control staff of the KMC.

REFERENCES

1. Siddons LB. *Anopheles stephensi*, as a vector of malaria in Calcutta. *J Malar Inst India* 1946; *6*: 367–76.
2. Hati AK, Chatterjee KK, Biswas D. Daytime resting habits of *Anopheles stephensi* in an area of Calcutta. *Indian J Malariol* 1987; *24*: 85–7.
3. *Manual on practical entomology in malaria, methods and techniques,* Pt II. Geneva: World Health Organization (Offset Pub.) 1975.
4. Bang YN, Bown DN, Onwubike AO. Prevalence of larvae of potential yellow fever vectors in domestic water containers in Southeast Nigeria. *Bull World Health Organ* 1981; *59:* 107–14.
5. Rattanaritikul Rampa, Harrison Bruce A. An illustrated key to the *Anopheles* larvae of Thailand. Bangkok, Thailand: United States Army Medical Component Southeast Asia Treaty Organization 1973; p. 12.
6. Christophers SR. *The fauna of British India including Ceylon and Burma*, v IV. London, UK: Taylor and Francis 1933; p. 1–360.
7. NIMR Field Station, Chennai. Available from: *http// www.mrcindia.org/chennai.hmt*.
8. Covell G. Malaria in Bombay. Bombay: Central Government Press 1928; p. 113.

Correspondence to: Dr Debashis Biswas, Senior Vector Control Officer & Chief Entomologist, Vector Control Department, Kolkata Municipal Corporation, 149 AJC Bose Road, Kolkata–700 014, India.

Received: 5 August 2010 *Accepted in revised form:* 18 January 2011