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Epidemiological and entomological aspects of malaria in forest-fringed villages of Sonitpur district, Assam

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Background & objectives : Detailed epidemiological and entomological studies were undertaken in forest-fringed villages and a Tea Estate in Sonitpur, Assam to assess the malaria situation.

Methods : Door-to-door active surveillance was carried out to collect blood samples. Thick and thin blood smears stained with Giemsa were used for malaria parasite detection. Mosquito collections were made using CDC miniature light-traps and hand catch methods from dusk-to-dawn.

Results : 48% SPR, 49.1 *Pf%* was recorded from the study villages. Children between 10 and 14 years were most sufferers. Per trap night density of mosquitoes in human dwellings was 204.3 and in cattlesheds — 908.7, *An. minimus* accounted for 20.7% of total malaria vectors.

Interpretation & conclusion : The results showed high malaria risk in the study villages. High vector density with high parity rate, poor socio-economic conditions, lack of awareness, poor sanitation and congenial atmosphere for mosquito proliferation are aggravating the malaria situation more complex in the study area.

Key words Entomological & epidemiological investigations – forest-fringed villages – malaria

Malaria still remains as one of the major public health problems in India. Despite antimalaria measures under NAMP (now National Vector Borne Diseases Control Programme), the transmission of malaria continues to be uninterrupted. Northeastern region of India is one of the hot spots of malaria. Focal outbreaks of malaria are of common occurrence especially in forest-fringed villages on Assam-Arunachal Pradesh border occupied by new settlers[1]. Morbidity and mortality due to *P. falciparum* infection is increasing day-by-day[2]. Geographical locations, tropical climate and socio-economic conditions make it an excellent abode for occurrence and persistent transmission of malaria in this region. Moreover, vast ecological changes have occurred due to deforestation in this region in the recent years, which created enormous mosquitogenic conditions. Predominance of *P. falciparum,* the killer parasite in Assam, presence of asymptomatic carriers of the parasite in the community and *An. minimus,* the major vector support the perennial transmission of malaria[3–7]. Incrimination of *An. dirus* from Dibrugarh district[8], *An. fluviatilis* from Boko areas of Assam[9] and *An. culicifacies* from Garubandha area of Sonitpur district, Assam[10] also confirmed their supporting role in the transmission of the disease. There have been sporadic reports on malaria incidence and short-term entomological surveys of various parts of the state have been carriedout[1–3,10]. Control of malaria poses a major challenge and its high incidence is detrimental to all round development of this region.

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In this communication, a study on epidemiological and entomological aspects of malaria in forest-fringed villages and Tea Estate of Sonitpur district (Assam) bordering Arunachal Pradesh during July 2003 is presented.

Material & Methods

Study area : District Sonitpur lies in the northern part of Assam sharing border with Arunachal Pradesh. The district is on the longitude 92° 20'E to 93°45'E and latitude of 26° 20'N to 27° 05'N. It covers an area of 5324 km^2. The study area is comprised of two forest-fringed villages, Kekurijan and Balijanbanua and one Tea Estate (Duflagurh) located on Assam-Arunachal Pradesh border under Gohpur PHC in Sonitpur district (Assam). This is a foothill area with large forestation, covered with tall trees, dense under growth intersected by slow flowing perennial streams and nallahs forming innumerable water pockets and some marshy lands. The villages are scattered, thinly populated and difficult to approach and unreachable by road during flood. Inhabitants are mainly *Adibasis* (tribals) and tea garden labourers with some migratory population of Nepalee origin. Human dwellings are made of split bamboos with thatched roofs often with an adjacent cattleshed. Socio-economic condition of villagers is poor and the people solely depend on paddy cultivation and collection of forest products. Forested terrain and perennial streams/nallahs maintain moderate climate throughout the year, which is congeneal for rapid multiplication and longevity of malaria vectors.

Epidemiological investigations : Door-to-door collection of blood samples from fever cases was carried out in two affected forest-fringed villages and one tea garden (active case detection — ACD). Blood samples (both thick and thin smears) were stained with Giemsa and examined under the microscope. Presumptive treatment was given to all fever cases during collection of blood samples followed by radical treatment to all malaria positive cases as per NAMP policy[11] by malaria workers to check further transmission of the disease. Indoor residual spray with Decis 2.8% EC @ 25 mg/m^2 and impregnation of bednets with K-othrine flow (deltamethrin) 2.5% SC @ 25 mg/m^2 were carried out in the study villages to reduce man-mosquito contact. Epidemiological parameters such as SPR, SFR, *Pf* %, age and sex wise distribution of malaria cases were analysed.

Entomological investigations : Adult mosquitoes were collected from human dwellings and cattlesheds with the aid of 6-volt battery-operated CDC miniature light traps (Communicable Disease Centre, USA) from dusk-to-dawn (1800–0500 hrs). Traps were hung in the middle of the room at a height of about two metres from the ground level. Smoking and other illuminations were prevented during the operation of the traps. Hand catch collection of adult mosquitoes was also made between 1800 and 2100 hrs with the help of aspirator tube. Mosquitoes were identified using standard keys. Alive vector mosquitoes— *An. philippinensis* (110), *An. minimus* (90) and *An. culicifacies* (50) were dissected to determine their physiological age and sporozoite infection of salivary glands[12].

Results & Discussion

Examination of blood smears revealed 48% slide positivity rate (SPR) ranging between 33.7 and 55.9. *P. falciparum* infection accounted for 49.1% of the total cases, which indicates the gradual decrease of *P. falciparum* in this area (Table 1). Highest SPR was recorded in Balijanbanua village (55.9%) followed by Duflagurh T.E. (51.8%) and lowest in Kekurijan village (33.7%). Analysis of data revealed a little difference in the incidence of malaria among male and female population indicating the SPR 50 and 46.1% respectively, which confirms the earlier observations made in Arunachal Pradesh[13], Nalbari district of Assam[3], in Rajmahal Range, Bihar[14] and in Lakhimpur district, Assam[1]. Maximum number of infection was recorded in the population between 5 and 14 yr of age (Table 2). This is in conformity with the earlier observations made by Dutta and Rajvir[15] in north Indian districts, in Rajmahal Range, Bihar[14] and in Assam[1].

Table 1. Results of active surveillance of malaria in forest-fringed villages of Sonitpur district (Assam)

Village	Pop	BSC/E	Malaria +ve	*Pv*	*Pf*	SPR	SFR	*Pf*%
Kekurijan	545	89	30	25	5	33.7	5.6	16.7
Balijanbanua gaon	320	68	38	8	30	55.9	44.1	78.9
Duflagurh T.E.	1252	199	103	54	49	51.8	24.6	47.6
Total	2117	356	171	87	84	48	23.6	49.1

Pop—Population; BSC/E—Blood slides collected/examined; *Pv—Plasmodium vivax; Pf—Plasmodium falciparum;* SPR—Slide positivity rate; SFR— Slide falciparum rate.

Table 2. Incidence of malaria among different age groups

Age group	BSC/E	Malaria +ve	*Pv*	*Pf*	SPR	SFR	*Pf*%
0–11 months	8	3	2	1	37.5	12.5	33.3
12–23 months	7	3	2	1	42.5	14.3	33.3
2–4 yr	24	11	5	6	45.8	25	54
5–9 yr	78	40	21	19	51.3	24.4	47.5
10–14 yr	47	26	10	16	55.3	34	61.5
>15 yr	192	88	47	41	45.8	21.4	46.6
Total	356	171	87	84	48	23.6	49.1

Table 3. Collection of mosquitoes by CDC light-trap in forest-fringed villages and Tea Estate

Species	Kekurijan village	Balijanbanua village	Duflagurh T.E.	Human dwellings	Cattlesheds	Total (per trap-night)	% collected
Anopheles annularis	61	56	19	31 (5.2)	105 (15)	136 (10.5)	1.8
An. barbirostris	461	294	27	51 (8.5)	731 (104.4)	782 (60.2)	10.3
An. crawfordi	123	132	92	31 (5.2)	316 (45.1)	347 (26.7)	4.6
An. culicifacies	15	21	11	10 (1.7)	37 (5.2)	47 (3.6)	0.6
An. kochi	155	257	37	91 (15.2)	358 (51.1)	449 (34.5)	5.9
An. minimus	50	81	26	49 (8.2)	106 (15.1)	157 (12.1)	2.1
An. philippinensis	101	183	26	95 (15.8)	215 (30.7)	310 (23.8)	4.1
An. tessellatus	2	27	–	10 (1.7)	19 (2.7)	29 (2.2)	0.4
An. vagus	71	175	96	92 (15.3)	250 (35.7)	342 (26.3)	4.5
An. varuna	41	69	8	20 (3.3)	98 (14)	118 (9.1)	1.6
Culicines (11 spp)	3026	1230	614	746 (131)	4124 (589.1)	4870 (374.6)	64.2
Total	4106	2525	956	1226 (204.3)	6361 (908.7)	7587 (583.6)	100

*Figures in parentheses indicate per trap-night collection of mosquitoes.

Children between 10 and 14 yr of age were the worst sufferers (55.3 SPR).

In entomological surveys, 10 species of anopheline and 11 species of culicine mosquitoes collected from human dwellings and cattlesheds in 13 trap nights revealed 583.6 per trap-night density. Per trap-night density of mosquitoes in human dwellings and cattlesheds recorded as 204.3 and 908.7 respectively (Table 3). Anophelines accounted for 35.8 % of the total mosquito collection with 80 and 372.8 per trap-night density in human dwellings and cattlesheds respectively. Malaria vectors encountered were *An. philippinensis* (310), *An. minimus* (157), *An. varuna* (118), *An. culicifacies* (47) and *An. annularis* (136), which formed 27.9% of the total anopheline collected. Highest collection of malaria vectors was made from cattlesheds than from human dwellings. Similar observations were also made from other parts of northeastern region[3,16]. *An. minimus*, the major vector of malaria in northeastern region of India constituted for 20.7% of the total malaria vectors encountered. Dissection of malaria vectors revealed high parity rate (64.4%) ranging between 61.3 and 68%, which gives a strong indication about their vectorial status in the transmission of the disease[14,15]. However, no anopheline could be incriminated as malaria vector.

Although, no infection could be detected in any of the anophelines collected during the present study the preponderance of *An. minimus* in the collection indicates that it is the most probable vector in this situation. However, the role of *An. philippinensis* (40.9% of malaria vectors collected) in the transmission of the disease cannot be ruled out as this species has been documented as the vector of malaria in Assam and Meghalaya[17–19]. It appears that *An. philippinensis* is establishing as a major species owing to increased paddy cultivation by clearing forests thereby disrupting the ecological niche of *An. dirus*[20]. *An. culicifacies,* which has recently being incriminated as a malaria vector from Garubandha area in Sonitpur district of Assam[10] has the possibility of playing a supporting role in the transmission of the disease. *An. annularis* and *An. varuna* may not be major vectors of malaria but have an importance as local vectors in several localities[21].

The study area had high incidence of malaria. Difficult terrain and poor communication make the situation more complex. The present study though very limited in its scope, revealed that variety of anophelines maintain a high density. High vector density with high parity rate, the poor socio-economic condition, lack of awareness in community about malaria, poor sanitation and presence of parasite load in the community make the population more vulnerable for contacting malaria, as locals are not in the habit of using mosquito nets or any other personal protection measures. Since villagers lack awareness about malaria and to achieve community compliance in public health programme, health education is urgently required in this area. Repeated infections due to frequent man-mosquito contact and non-clearance of parasites from the blood because of under-dosage of antimalaria drugs may develop immunity and asymptomatic carriers in the community[1]. Unlike other parts of the country, the major malaria vectors are still susceptible to 4% DDT in Assam[2,6]. So, promoting use of impregnated bednets as personal protection measure, reasonable coverage and methodical indoor residual spraying, coupled with reduction of parasitic load in the community through surveillance, timely therapeutic measures and organizing malaria awareness camps can certainly improve the situation in this area.

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