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Malaria situation in forest-fringed villages of Sonitpur district (Assam), India bordering Arunachal Pradesh during an outbreak

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Abstract

Background & objectives: Epidemiological and entomological studies were undertaken in forest-fringed villages in Sonitpur district (Assam) bordering Arunachal Pradesh, India to assess the malaria situation. Blood smears (thick and thin) were collected from the fever cases through door-to-door survey. Both the blood smears stained with Giemsa were used for malaria parasite detection. Slide positivity rate (SPR) was recorded as 39.1% with predominance of *Plasmodium falciparum* (97.1%) infections. Children between 5 and 14 yr showed higher rates of infection.

Methods & Results: Over all malaria prevalence was higher among the males (SPR 43.2%) than in females (SPR 34.5%). Adult mosquito collection was made using CDC miniature light-traps from dusk-to-dawn. Per-trap night density of mosquitoes in human dwellings and cattlesheds were 289 and 925, respectively. *Anopheles minimus* and *An. dirus*, the major vectors of malaria in Northeastern region of India formed 33.2% of the total vectors recorded. *An. dirus* could be recorded only from human dwellings. The results showed high malaria risk in the study villages.

Interpretation & conclusion: 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 in the study area.

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

Introduction

Malaria still remains as the major public health problems in India. Despite numerous control measures, malaria continues to be uninterrupted with high morbidity and mortality in the area of its occurrence. Northeastern region of India is one of the hot spots for malaria transmission. Focal outbreaks of malaria are of common occurrence especially in forest-fringed villages of Sonitpur district (Assam) bordering Arunachal Pradesh occupied by new settlers[1]. Perennial and persistent transmission of malaria is well known in this region because of *Plasmodium falciparum* resistant to antimalarial drugs[2,3], efficient anthropophagic vectors, congenial climatic conditions for mosquito breeding, high man-vector contact, lack of awareness and low socio-economic conditions[1]. The dominance of *P. falciparum*[1,4–7], and *Anopheles minimus* and *An. dirus* (Diptera: Culicidae), the major anthropophagic vectors of malaria in Northeastern region of India support the continued transmission of the disease[5,6,8,9]. Incrimination of *An. fluviatilis* from Boko area[10] and *An. culicifacies* from Garubandha area of Sonitpur district of Assam[11] as

malaria vectors, also confirmed their supporting role in the transmission of the disease. Moreover, vast ecological changes have taken place in this region in recent years due to deforestation causing enormous mosquitogenic conditions[12]. Deforestation and opening up of new land in forest areas either for crop cultivation or settlement due to increased population have brought some changes in eco-environment, which influenced the transmission of the disease resulting in some changes in behavioural aspects of the vector species[7]. Thus, it is essential to review the distribution and species composition of vector mosquitoes in a given area for adopting any vector control strategy.

So far the information on the incidence of malaria and prevalence of malaria vectors species in the forest-fringed villages in Sonitpur district (Assam), bordering Arunachal Pradesh is very scanty and hence a study on epidemiological and entomological aspects of malaria during a malaria outbreak in June 2005 is undertaken.

Material & Methods

Study area: The District Sonitpur lies in the northern parts of mighty Brahmaputra in 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 with 14,24,287 population. The climate of the district is warm, subtropical, the summer and the winter temperature vary from 7 to 36°C. The average annual rainfall is between 170 and 220 cm. The study area comprised of three forest-fringed villages—Nigam, Khola camp and Kadamguri with about 2,750 population, located on Assam–Arunachal Pradesh border under Balipara primary health centre (PHC) in Sonitpur district. This foothill area with large forestation, covered with tall trees, dense under growth, intersected by slow flowing perennial streams, *katcha* nallahs and drains forming innumerable water pockets provide perennial breeding sites for mosquitoes. The villages are small, sparsely populated and unreachable during rainy season; mainly inhabited by socioeconomically backward tribal people, solely dependant on paddy cultivation and collection of forest products. The villagers traditionally use scanty clothes on their bodies and by habit do not use mosquito nets or any other protective measures against mosquito bites. The houses are of thatched roofs with mud plastered walls, often with adjacent cattleshed (open shed without walls). Climate is tropical in this area. Forested terrain and perennial streams/nallahs maintain moderate climate throughout the year, which is congenial for rapid multiplication and longevity of malaria vectors.

Epidemiology: Door-to-door collection of blood smears (thick and thin) from fever cases was carried out in three affected villages and two schools (Active case detection—ACD). Blood samples 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 National Vector Borne Disease Control Programme (NVBDCP) policy[13] by malaria workers to check further transmission of the disease. Epidemiological parameters such as slide positivity rate (SPR), slide falciparum rate (SFR), *Pf%*, age and sex-wise distribution of malaria cases were analysed.

Entomology: Since the collection of adult mosquitoes by hand-catches varies from man-to-man and thus adversely affects the estimation of vector population in a given area, to overcome this problem various traps have been developed for collection of mosquitoes[14–16]. In the present study, 6-volt battery operated CDC miniature light-trap was used for collection of adult mosquitoes from the human dwellings and cattlesheds. The traps were hung at the middle of the huts about two metre above the ground and run from dusk-to-dawn (1800 to 0500 hrs). Collected mosquitoes were identified as per the standard keys. Alive vector mosquitoes were dissected to determine their

physiological age and sporozoite infection of salivary glands[17].

Results & Discussion

Epidemiological survey: Examination of blood samples (437) revealed SPR as 39.1% ranging between 26.3 and 61.1% with 97.1% *P. falciparum* infection (Table 1). Highest SPR was recorded in Kadamguri village (61.1%) followed by Nigam village (51.5%) and lowest in Khola camp village (26.3%). Examination of blood samples from school children revealed 26.9% SPR, which indicates active transmission of the disease in this area. Analysis of the data revealed difference in the incidence of malaria among males and females population indicating the SPR 43.2 and 34.5%, respectively (Table 2), which confirms the earlier observations made in Arunachal Pradesh[18], Nalbari district of Assam[6], in Rajmahal Range, Bihar[19] and in Lakhimpur district, Assam[1]. Population between 5 and 14 yr of age were affected more, while children of age group between 10 and 14 yr were the most sufferers (SPR 46.1%) (Table 3). Similar observations have also been reported from North Lakhimpur and Sonitpur district of Assam[1,12].

Table 1. Malaria incidence in forest-fringed villages in Sonitpur district (Assam) bordering Arunachal Pradesh

Village	BSC/E	Total (+ve)	*Pf*	SPR	SFR	*%Pf*
Nigam	171	88	83	51.5	48.5	94.3
Khola Camp	152	40	40	26.3	26.3	100
Kadamguri	36	22	22	61.1	61.1	100
Nigam Primary School	52	14	14	26.9	26.9	100
Bhalukpong L.P. School	26	7	7	26.9	26.9	100
Total	437	171	166	39.1	26.9	97.1

BSC/E—Blood slides collected/examined; SPR—Slide positivity rate; SFR—Slide falciparum rate.

Table 2. Sex-wise distribution of malaria incidence

Sex	BSC/E	Total (+ve)	*Pf*	SPR	SFR	*%Pf*
Male	234	101	98	43.2	41.9	97
Female	203	70	68	34.5	33.5	97.1
Total	437	171	166	39.1	38	97.1

Table 3. Malaria incidence in different age groups

Age group	BSC/E	Total (+ve)	*Pf*	SPR	SFR	*%Pf*
0–11 month	2	–	–	–	–	–
12 –23 month	17	4	3	23.5	17.6	75
2–4 yr	76	26	24	34.2	31.6	92.3
5–9 yr	120	55	54	45.8	45	98.2
10–14 yr	89	41	41	46.1	46	100
>15 yr	133	45	44	33.8	33.1	97.8
Total	437	171	166	39.1	38	97.1

Entomological survey: A total of 4,856 mosquitoes comprised of 15 species of anophelines and 11 species of culicines were collected from human dwellings and cattlesheds in eight trap-nights. Per trap-night density of mosquitoes in human dwellings and cattlesheds was recorded as 289 and 925, respectively (Table 4). Anophelines accounted for 39.2% of the total mosquito collection with 110 and 366.8 per trap-night density in human dwellings and cattlesheds respectively. Malaria vectors encountered were *An. annularis, An. culicifacies, An. dirus, An. fluviatilis, An. maculatus, An. minimus, An. philippinensis* and *An. varuna*, which formed 44.5% of the total anophelines collected. The collection of malaria vectors made in cattlesheds was higher than from human dwellings. Similar observations were also made from other parts of Northeastern region[1,7,12] and from Chhattisgarh[20]. *An. dirus* could be recorded only from human dwellings, which indicates anthropophagic nature of this species. *An. minimus* and *An. dirus*, the major vectors of malaria in Northeastern region of India constituted 33.2% of total malaria vectors en-

Table 4. Collection of mosquitoes from forest-fringed villages by CDC light-traps

Species	Human dwellings	Cattlesheds	Total	Parity rate
Anopheles aconitus	20 (5)	68 (17)	88 (11)	–
An. annularis	36 (9)	106 (26.5)	142 (17.8)	63.3
An. barbirostris	36 (9)	135 (33.8)	171 (21.4)	–
An. crawfordi	82 (20.5)	323 (80.8)	405 (50.6)	–
An. dirus	14 (3.5)	–	14 (1.8)	64
An. culicifacies	18 (4.5)	54 (13.5)	72 (9)	65.2
An. fluviatilis	4 (1.3)	9 (2.3)	13 (1.6)	69.1
An. jamesi		11 (2.8)	11 (1.3)	–
An. karwari	21 (5.2)	171 (42.8)	192 (24)	–
An. kochi	26 (6.5)	91 (22.8)	117 (14.6)	–
An. maculatus	52 (13)	175 (43.8)	227 (28.4)	67.2
An. minimus	29 (7.3)	115 (28.8)	144 (18)	70.7
An. philippinensis (*An. nivipes*)	68 (17)	143 (35.8)	211 (26.4)	61
An. vagus	26 (6.5)	46 (11.5)	72 (9)	–
An. varuna	8 (2)	16 (4)	24 (3)	65
Culicines (11 spp)	716 (179)	2237 (559.3)	2953 (369.1)	–
Total	1156 (289)	3700 (925)	4856 (607)	

Figures in parentheses indicate per-trap night density.

countered. Dissection of malaria vectors revealed high parity rate (65.7%) ranging between 61 and 70.7%, which gives a strong indication about their vectorial status in the transmission of the disease[19,21]. However, no anopheline could be incriminated.

Although, the present study is very limited in its scope, it reveals that variety of anophelines maintain a high density in this area. In the recent past, survey carried out in forest-fringed villages of North Lakhimpur[1] and Sonitpur district[12] of Assam recorded 10 to 11 anopheline species where *An. dirus* and *An. fluviatilis* were altogether absent in their survey. The present study recorded 15 anopheline species including *An. dirus* and *An. fluviatilis*. In similar studies carried out in Tirap and Subansiri districts of Arunachal Pradesh by Malhotra *et al*[22], 18 anopheline species were observed but *An. minimus* could not record.

Although no sporozoite infection could be detected in any of the anophelines collected during the present study, the presence of *An. dirus* and *An. minimus*, the major vectors in Northeastern region in the collection indicate their probable role in the transmission of the disease. However, the role of *An. philippinensis* (*An. nivipes*) (24.9% of total malaria vectors encountered) and *An. maculatus* (26.8% of malaria vectors collected) in transmission of the disease can not be ruled out as these species have been documented as the vectors of malaria in Assam and Meghalaya[23–25]. It appears that *An. philippinensis* (*An. nivipes*) is establishing itself as a major species owing to increased paddy cultivation by clearing forest thereby disrupting the ecological niche of *An. dirus*[26]. *An. culifacies*, which was recently being incriminated as malaria vector from Garubandha area in Sonitpur district of Assam[11] has the possibility of playing supporting role in the transmission of malaria. *An. annularis* and *An. varuna* may not be major vectors of malaria but have importance as local vectors in several localities[27].

The study area has high incidence of malaria. Difficult terrain and poor communication make the situ-

ation more complex. *P. falciparum* was recorded as the predominant species causing considerable morbidity and mortality. Malaria transmission in forest-fringed villages was observed as intense because of *Pf* resistance to antimalarials, efficient vectors, innumerable mosquito breeding sites and ecological conditions favouring vector longevity and rapid multiplication. High vector density with high parity rate and presence of parasitic load in the community are the prime causes for the perennial transmission of malaria in these forest-fringed villages. Since villagers lack awareness about malaria and it is pertinent to achieve community compliance in public health programme, health education is urgently required in this area. Repeated infections and non-clearance of parasites from the blood because of under dosage of antimalarial drugs may lead to development of immunity and asymptomatic carriers in the population[1]. Unlike other parts of the country, the major malaria vectors are still susceptible to DDT in Assam[2,9]. So, promoting the use of impregnated bednets as personal protection measures, reasonable coverage and methodical indoor residual spraying, coupled with reduction of parasitic load in the community through surveillance, timely therapeutic measures and organising malaria awareness camps can certainly improve the situation in this area.

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