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THE PREVALENCE OF MALARIA IN AN ENDEMIC AREA OF BANGLADESH

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Abstract: Eight hundred and nine patients with the symptom of fever at a rural health complex in southeastern Bangladesh were studied for the presence of malaria: 48.1% were malaria parasite-positive. Of these patients 71.5% had falciparum malaria and 28.5% had vivax malaria. The 5~9 years age group had the highest percentage of malarial parasite positivity (58.6%). Splenomegaly was found more frequently in children than in adults. By occupation, malaria was most prevalent among woodcutters who worked in forests. Forest dwellers in general had a significantly higher ($p<0.001$) malaria positivity rate than did those persons residing in non-forested areas. Indigenous tribal people had significantly lower ($p<0.05$) malaria-positivity than did Bengalee settlers. Illiteracy and low incomes, customary reasons for failure to practice prevention, were associated with higher prevalence of malaria.

INTRODUCTION

The incidence of malaria in Bangladesh is worsening. The development of drug reistant strains of *Plasmodium falciparum* (*P. falciparum*) as well as generally ineffective chemoprophylaxis may have contributed to this state of affairs (Waiz and Chakraborty, 1986; Waiz and Chakraborty 1990). Malaria is endemic in the districts of Bandarban, Rangamati, Khagrachari, Cox's Bazar, which are located in southeastern Bangladesh, and, in the border area of Mymensingh and Sylhet (Begum *et al.*, 1988). The malaria eradication program started in 1961 (Hossain *et al.*, 1984) faltered during the liberation war of 1971. By the recommendation of the World Health Organization (WHO), this malaria eradication program was changed in 1977 to a malaria control program, which was integrated into the primary health care system (Rahman, 1991).

Monitoring the incidence and prevalence of malaria may identify high risk groups and help to guide malaria control activity. Unfortunately, surveillance and reporting of malaria cases in most malaria endemic countries has been haphazard at best (Oaks *et al.*, 1991). The present study was aimed at obtaining an accurate picture of malaria situation in Kaptai, which is located in the Rangamati district of Bangladesh. Specific questions to addressed included (i) the distribution of different *Plasmodium* species; (ii) the relationship between types of malaria and the age, sex, occupation, race, level of education, and economic status of infected patients; and (iii) the parasite-positive rate and the ratio of *P. falciparum* and *P. vivax* among fever cases.

MATERIALS AND METHODS

Location

Kaptai Thana Health Complex was selected for this study. This area is hilly and forested and located in Rangamati district (Figure 1). The total population within the purview Kaptai Thana Health Complex is 52, 653. The populations are indigenous tribal and non-tribal Bengalee settlers.

Patients

All patients with the complaints of fever attending the out-patient clinic of the health complex were included in the study. Verbal consent was obtained from patients and/or parents of the patients. No patient was taking any chemoprophylaxis for malaria. Information concerning the age, sex, educational qualifications, total monthly family income, occupation, population category, housing conditions were also included in this study, which comprised 809 cases. There were 414 male and 395 females. Ages of the patients ranged from 0.33 to 82 years. Their median age was 19 years. However due to unavoidable circumstances, only the age and population

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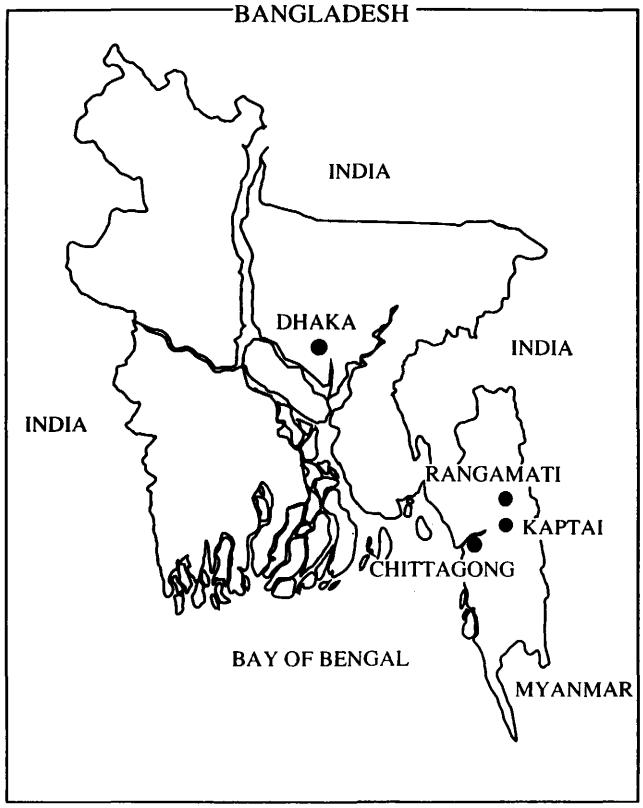

Figure 1 Location of the study place.

information could be obtained in 165 cases.

Diagnosis of malaria

Venous blood was taken from all patients with fever. A smear immediately was made and stained with 3% Giemsa stain. At least 100 fields were viewed extensively under an oil-immersion lens, by a technician and by one of the authors.

Detection of splenomegaly

Abdominal palpation was done by one of the investigators for the diagnosis of splenomegaly.

Statistical analysis

Statistical analysis was done by *Chi square test*

RESULTS

Table-1 shows the distribution of malaria patients by age. Malarial parasites were found in peripheral blood smears in 389 (48.1%) cases out of 809 cases. Among them, 278 (71.5%) were *P. falciparum* and 111 (28.5%) were *P. vivax*. The highest prevalence (58.6%) was found in the age group 5~9 years. The lowest (29.4%) was found in the age group 55 years and older.

In a total of 414 male cases with fever, 209 (50.5%) were malaria parasite (MP) positive; 137 (65.5%) cases were *P. falciparum* and 72 (34.5%) cases were *P. vivax*. In 395 female cases with fever, 180 (45.6%) were MP positive; 141 (78.3%) cases were *P. falciparum* and 39 (21.7%) cases were *P. vivax* (Table-2). Although

Table 1 *Distribution of malarial parasite positive cases by age.*

Age group (yrs)	No. of fever cases	No. of malaria parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
< 1	19	8 (100)	0	8 (100)	42.1
1 — 4	112	43 (75.4)	14 (24.6)	57 (100)	50.9
5 — 9	162	67 (70.5)	28 (29.5)	95 (100)	58.6
10—14	87	26 (61.9)	16 (38.1)	42 (100)	48.3
15—19	86	31 (72.1)	12 (27.9)	43 (100)	50
20—24	92	25 (69.4)	11 (30.6)	36 (100)	39.1
25—29	61	19 (76.0)	6 (24.0)	25 (100)	41
30—34	57	21 (72.4)	8 (27.6)	29 (100)	50.9
35—39	29	10 (66.7)	5 (33.3)	15 (100)	51.7
40—44	29	9 (75.0)	3 (25.0)	12 (100)	41.4
45—49	17	5 (62.5)	3 (37.5)	8 (100)	47.1
50—54	24	8 (88.9)	1 (11.1)	9 (100)	37.5
55<	34	6 (60.0)	4 (40.0)	10 (100)	29.4
Total	809	278 (71.5)	111 (28.5)	389 (100)	48.1

*MP: Malarial parasite, percentage of malarial parasite positive cases among fever cases. Parenthesis is the percentage.

Table 2 *Distribution of malarial parasite positive cases by sex.*

Sex	No. of fever cases	No. of malarial parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
Male	414	137 (65.6)	72 (34.5)	209 (100)	50.5
Female	395	141 (78.3)	39 (21.7)	180 (100)	45.6
Total	809	278 (71.5)	111 (28.5)	389 (100)	48.1

*MP: Malarial parasite, percentage of malarial parasite positive cases among fever cases. Parenthesis is the percentage.

Table 3 *Frequency of malarial parasite positive cases by living environment.*

Living environment	No. of fever cases	No. of malarial parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
Inside Forest	344	141 (68.8)	64 (31.2)	205 (100)	59.6
Outside Forest	300	84 (71.2)	34 (28.8)	118 (100)	39.3†
Total	644	225 (69.7)	98 (30.3)	323 (100)	50.2

*MP: Malarial parasite, percentage of malarial parasite positive cases among fever cases. †Outside forest vs. inside forest, $p<0.001$. Parenthesis is the percentage.

Table 4 *Distribution of malarial parasite positive cases by preventive measures.*

Preventive measures	No. of fever cases	No. of malarial parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
Practiced Mosquito net	217	65 (70.7)	27 (29.3)	92 (100)	42.4
Mosquito coil	1	0	0	0	0
Smoke	65	22 (59.5)	15 (40.5)	37 (100)	56.9
Multiple measures	66	6 (54.6)	5 (45.5)	11 (100)	16.7
Total	349	93 (66.4)	47 (33.6)	140 (100)	40.1
Not practiced	295	132 (72.1)	51 (27.9)	183 (100)	62†
Total	644	225 (69.7)	98 (30.3)	323 (100)	50.2

*MP: Malarial parasite, percentage of malarial parasite positive cases among fever cases.
†Preventive measures practiced vs. not practised, $p<0.001$.
Parenthesis is the percentage.

Table 5 *Distribution of malarial parasite positive cases by occupation.*

Occupation	No. of fever cases	No. of malarial parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
Cultivation	69	29 (65.9)	15 (34.1)	44 (100)	63.8
Woodcutter	28	14 (63.6)	8 (36.4)	22 (100)	78.6
Labour	30	13 (68.4)	6 (31.6)	19 (100)	63.3
Service	24	7 (70.0)	3 (30.0)	10 (100)	41.7
Business	20	4 (80.0)	1 (20.0)	5 (100)	25
Household Chores	156	39 (76.5)	12 (23.5)	51 (100)	32.7
Student	116	31 (58.5)	22 (41.5)	53 (100)	45.7
Non-Occupational (0-10 yrs Children)	165	79 (79.0)	21 (21.0)	100 (100)	60.6
Other Occupation	36	9 (47.4)	10 (52.6)	19 (100)	52.8
Total	644	225 (69.7)	98 (30.3)	323 (100)	50.2

*MP: Malarial parasite, percentage of malarial parasite positive cases among fever cases.
Parenthesis is the percentage.

malaria was found more in the male than the female patients, no statistical significance was found in this study.

Among 644 cases with fever, 344 cases lived within the forest and 300 cases lived outside the forest (Table -3). MP positive was found in 205 (59.6%) cases who lived within the forest, 141 (68.8%) and 64 (31.2%) cases were falciparum and vivax malaria respectively. MP positive were found in 118 (39.3%) cases who lived outside the forest, 84 (71.2%) cases and 34 (28.8%) cases were falciparum and vivax malaria respectively. The frequency of MP positive cases by living environment was statistically significant ($p<0.001$).

In a total of 323 MP positive cases 140 cases used mosquito preventive measures such as mosquito net, mosquito coil, smoke, and 183 cases did not use them (Table-4). There is significant difference ($p<0.001$) of MP positive cases between mosquito preventive measures practiced and those did not. In practiced cases falciparum and vivax malaria were 93 (66.4%) and 47 (33.6%) respectively. In non-practiced cases 132 (72.2%) were *P. falciparum* and 51 (27.9%) were *P. vivax*.

According to the occupation out of 69 cultivators, 28 woodcutters, 30 laborers, 24 service holders, 20 bussinessmen, 156 persons doing household chores, 116 students, 165 non-occupational and 36 other occupational groups of fever cases; 44 (63.8%), 22 (78.6%), 19 (63.3%), 10 (41.7%), 5 (25%), 51 (32.7%), 53 (45.7%), 100 (60.6%) and 19 (52.8%) cases were MP positive respectively (Table-5).

The most affected group was those with a monthly family income of Taka<1000 (Table-6); out of 48 fever cases, 33 (68.6%) were MP positive cases. In the group with an income of Taka 1001~2000; out of 297 febrile cases, 196 (66%) were MP positive. With family income of Taka 2001~3000; out of 205 febrile cases 72 (35.1%) were MP positive cases. In the income group with Taka 3001~4000; out of 72 febrile cases 17 (23.6%) cases and with Taka 4001~5000; out of 15 febrile cases 3 (20%) were MP positive cases. In the highest family income group earning Taka<5000, out of 7 fever cases 2 (28.8%) were MP positive cases.

Among febrile cases, 274 were illiterate, 180 patients had primary education, 36 had secondary education, 23 had higher secondary education, 4 had graduate

Table 6 *Distribution of malarial parasite positive cases by income.*

Monthly family income †	No. of fever cases	No. of malarial parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
<1000	48	21 (63.6)	12 (36.4)	33 (100)	68.8
1000—2000	297	140 (71.4)	56 (28.6)	196 (100)	66
2001—3000	205	51 (70.8)	21 (29.2)	72 (100)	35.1
3001—4000	72	9 (52.9)	8 (47.1)	17 (100)	23.6
4001—5000	15	3 (100)	0	3 (100)	20
>5000	7	1 (50.0)	1 (50.0)	2 (100)	28.6
Total	644	225 (69.7)	98 (30.3)	323 (100)	50.2

*MP: Malarial parasite, percentage of malaria parasite positive cases among fever cases. Parenthesis is the percentage. † Monthly family income expressed in Taka, 1US $=40.00 Taka (approximately).

Table 7 *Distribution of malarial parasite positive cases by educational qualifications.*

Educational Qualifications	No. of fever cases	No. of malarial parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
Illiterate	274	103 (68.2)	48 (31.8)	151 (100)	55.1
Primary	180	51 (63.8)	29 (36.3)	81 (100)	44.4
Secondary	36	7 (58.3)	5 (41.7)	12 (100)	33.3
Higher Secondary	23	6 (100)	0	6 (100)	26.1
Graduate	4	0	0	1 (100)	25
Infant & preschool	127	57 (78.1)	16 (21.9)	73 (100)	57.5
Total	644	225 (69.7)	98 (30.3)	323 (100)	50.2

*MP: Malarial parasite, percentage of malaria parasite positive cases among fever cases. Parenthesis is the percentage.

Table 8 *Distribution of malarial parasite positive cases by category of population.*

Population category	No. of fever cases	No. of malaria parasite positive cases			% of MP* positive cases
		P. falciparum	*P. vivax*	Total	
Tribal	56	13 (68.4)	6 (31.6)	19 (100)	33.9
Non-Tribal	753	265 (71.6)	105 (28.4)	370 (100)	49.1
Total	809	278 (71.5)	111 (28.5)	389 (100)	48.1

*MP: Malarial parasite, percentage of malaria parasite positive cases among fever cases.
Parenthesis is the percentage.
Incidence of malaria, tribal vs. nontribal, $p<0.05$.

Table 9 *Distribution of enlarged spleen by malarial parasite positive cases.*

Population	No. of fever cases	No. of enlarged spleen cases	No. of malaria parasite positive cases with enlarged spleen		
			P. falciparum	*P.. vivax*	Total
Children (0-10 yrs.)	244 (100)	57 (23.4)	33 (13.5)	11 (4.5)	44 (18.0)
Adults	400 (100)	46 (11.5)	27 (6.8)	11 (2.8)	38 (9.5)
Total	644 (100)	103 (16)	60 (9.3)	22 (3.4)	82 (12.7)

*MP: Malarial parasite, percentage of malarial parasite positive cases among fever cases.
Parenthesis is the percentage.

level education and 127 cases were infant and preschool children (children before the age to enter school); among them 151 (55.1%), 80 (44.4%), 12 (33.3%), 6 (26.1%), 1 (25%) and 73 (57.5%) cases were MP positive respectively (Table-7).

Out of 56 fever cases among the tribals, 19 (33.9%) cases were MP positive and out of 753 fever cases among the non-tribals, 370 (49.1%) cases were MP positive (Table-8). There is statistically significant ($p<0.05$) difference between the occurrence of malaria between the tribals and non-tribals. In the tribals 13 (68.4%) and 6 (31.6%) cases were *P. falciparum* and *P. vivax* respectively. In the non-tribals 265 (71.6%) and 105 (28.4%) cases were *P. falciparum* and *P. vivax* respectively. By analyzing 44 tribal cases with fever we found that out of 12 cases residing outside the forest, 3 cases were MP positive and out of 32 cases residing within the forest, 8 cases were MP positive. Interestingly, in both groups 25% were MP positive.

In a total 644 cases with fever splenomegaly was found in 103 (16%) cases (Table-9). Among children 57 (23.4%) cases had splenomegaly, 44 (18.0%) were MP positive and 13 (5.3%) were MP negative. Among the MP positive cases 33 (13.5%) and 11 (4.5%) had *P. falciparum* and *P. vivax* respectively. Splenomegaly was found in 46 (11.5%) adult cases, 38 (9.5%) were MP positive and 8 (2.0%) were MP negative. Among the MP positive cases, 27 (6.8%) and 11 (2.8%) were associated with *P. falciparum* and *P. vivax* respectively.

DISCUSSION

The present study has been designed to asses the cross sectional picture of distribution of different *Plasmodium* species in an endemic area of Bangladesh. This will virtually reflect the factors associated with the trends of malaria infection. The study was conducted in a forested hilly area. The communications from the residence of the health complex played an important role on patients' availability. Only those who had easy approach to the health complex attended the out-patient clinic for seeking treatment. The rest of the population were naturally dropped out from the study population.

A steadily increasing trend of malaria is being observed in Bangladesh. The slide positive rate (SPR) in Bangladesh was 2.4% and the *P. falciparum* infection was 20.2% in 1978. Whereas in 1982 the SPR reduced to 1.6% and the percentage of *P. falciparum* increased to 40.8%; in 1987 SPR further reduced to 1.2% and *P. falciparum* increased to 57.1% (Begum *et al.*, 1988). However, in 1988 the SPR became 1.3% and *P. falciparum* 61.4%: in 1989 SPR increased to 1.7% and *P. falciparum* 66.3%; and in 1990 SPR more increased to 2.2% and *P. falciparum* was 63.3% (World malaria situation in 1990, 1992). In the present study the parasite rate was 48.1% and, the *P. falciparum* and *P. vivax* proportion were 71.5% and 28.5% respectively. The proportion of *P. falciparum* in endemic area of Bangladesh varied

between 91~100% (Waiz *et al.*, 1989). The study was done in April and at that time the endemicity of malaria is usually low. There are two peaks of malaria incidence in the place of study. One takes place during the pre-monsoon. i.e. in June-July and the other in the post -monsoon i.e. in November-December (Rahman, 1991). As a consequence the distribution of different species of MP in the present study was found to be much lower than expected, although it still presents the endemic picture. In this study among 389 cases of malaria, only three were mixed infection by *P. falciparum* and *P. vivax*. In the results we included the mixed infections under *P. falciparum*. We did not find *P. malaria* infection among the patients (Begum *et al.*, 1988).

The incidence of malaria among different age groups varied on the levels of endemicity. It is believed that in Africa malaria is mainly a childhood disease, whereas in many places of Asia and South America it is a disease of young adult (Oaks *et al.*, 1991). In hyper/ holoendemic areas, malaria incidence is mostly confined to young children. On the other hand, in the zone of epidemic malaria, the disease is more or less distributed among different age groups during the epidemicity (Rahman, 1991). The prevelence of malaria increased gradually with age and the peak was found in the age group of 5~9 years. Then it decreased with the lowest in the 55+ age group. As regards occupation, the non -occupational group that is the children had the high prevalence of malaria and we found that <1 years group 42.1% fever cases were MP positive and all were *P. falciparum*. Our observation is consistent with the comment that there is no evidence for protection against malaria infection during the first months of life (Greenwood, 1991). According to occupation the most affected group was the woodcutters and next the laborers and cultivators had the similar high in prevalence because they are mostly exposed to the forest for their occupation. We also found that MP positive rate were significantly high in those living inside the forest. Apparently due to less exposure to the forest, bussinessmen, service holders and the persons doing house hold chores had less malaria. The prevalence of malaria in male were more than the female though statistical significance was not found. This higher prevalence of male may be due to more exposure to mosquitoes due to work related conditions.

The border areas and the continuous foot-hill areas in the northern, easterm and south-eastern foot-hills including Bandarban, Khagrachari, Rangamati *An. minumus* and *An. dirus* are the responsible vectors (Begum *et al.*, 1988). Fruitless vector control in forest areas is one of the reasons for higher MP positive rate in people living in the forest areas (Oaks *et al.*, 1991). As expected, our study showed that there was significantly less malaria those used vector prevention measures. Due to illiteracy and economic problems many people could not take preventive measures. Income and wealth clearly affect the severity of the malaria problem (Oaks *et al.*, 1991). Researchers have estimated that each case of malaria causes between 5 and 20 days of disability (Van, 1916; Russel and Menon, 1942; Malik, 1966; Conly 1975). In a developing country like Bangladesh this is a severe problem.

In malaria endemic area due to repeated experience of dense parasitemias the spleen progressively enlarge and in holo- or hyperendemis areas most of the children, but relatively few adults, have palpable splenomegaly due to malaria alone (Crane, 1991). In our study significantly high percentage of children with MP positive smear had splenomegaly compared to the adults. All cases with splenomegaly were Bengali settlers. No cases of splenomegaly was found among the indigenous tribal patients.

A lower incidence of malaria was found among the indigenous tribal people than the Bengalee settlers. Among the Bengalee settlers those were residing within the forest had a greater prevalence of malaria than those living outside the forest. This indicates Bengalee settlers has higher susceptibility than the tribal peoples. A similar result was found in Pakistan. There was higher incidence of malaria among Afgan refugees than among the indigenous population (Suleman, 1988). Indians of the Amazon, the pigmies of Central Africa, and aborigines of the Malaysians jungle, traditionally have been unaffected by malaria (Oaks *et al.*, 1991). Due to economic reasons there has been malaria-related morbidity and considerable mortality among the newcomers and the reintroduction or increase of malaria in indigenous population. From this study we can find that the forest-malaria condition in Bangladesh is different, the settlers are more infected than the indigenous population. However, many of these indigenous population have been residing and working within the forest. It deserve to mention here again that no case of splenomegaly was found in the tribal patients with malaria. There are evidences on the effect of HLA variation (Hill *et al.*, 1991) and ABO blood group (Hill, 1992) on the susceptibility to malaria. The factors which made the indigenous populations less susceptible to malaria in this area of Bangladesh certainly deserve further investigations.

Malaria treatment in this area is done to let the

patient survive the current acute episode without nescessarily eradicating the parasitemia (Oaks *et al.*, 1991). We think this type of treatment is not suitable to releive the morbidity and mortality. Because the source of infection will be more, rapid diagnosis and treatment must be done in these areas, because life-threatening disease can develop within hours. Rapid diagnosis and standard treatment must be nescessary for these people.

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