Malaria Baseline Socioeconomic and Prevalence Survey 2007

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EXECUTIVE SUMMARY

Malaria re-emerged as one of the major public health problems in Bangladesh in the 1990s. Out of the total 64 administrative districts, 13 are in the malaria endemic areas and the three Hill Tract Districts Rangamati, Khagrachari, and Bandarban in the very south-east of the country traditionally report the highest incidence of malaria within the country. The baseline survey aimed to study i) the knowledge/awareness of the respondents on malaria ii) their health-seeking behaviour relevant to malaria iii) study the possession and use patterns of bed net iv) the prevalence of malarial infection including species-specific prevalence (*P vivax and P falciparum*) and its distribution. An elaborate two-stage cluster sampling technique was employed to get a representative sample from the 13 endemic districts. This report present findings from this baseline survey to inform programme design and fine-tune appropriate interventions.

KEY FINDINGS AND IMPLICATIONS FOR PROGRAMME

Socioeconomic Survey

The key findings from the socioeconomic survey can be summarized as follows:

- The general health awareness of the respondents was high; those from south/south-east (SSE) area trailed behind those from the north/north-east (NNE) area, albeit marginally.
- However, the knowledge on causation, transmission, prevention and control of malaria was not comprehensive.
- Education, SES and gender were important determinants in shaping these different aspects of malaria; marginal differences were observed with respect to the two areas.
- The possession of at least one bed nets by the households was almost universal, the total number varying according to asset quintiles; however, insecticide treatment of bed nets was poor.
- Major proportion of patients with malaria-like febrile illness either did not seek any treatment or practiced self-treatment only.
- Of those who sought treatment, majority went to the informal allopathic providers; gender and SES gradient disfavouring women and poorest was observed.
- For majority of the patients, treatment was delayed beyond 24 hours.
- The cost for malaria-like illness is quite high, especially in the NNE area.

Implications for programme

- IEC component of the programme should aim at disseminating comprehensive information on malaria transmission, prevention and control; combination of audio-visual and print media will be required to reach the targeted audience such as the poorest households and the women.
- The IEC campaign should emphasize the necessity of EDPT so that community is convinced about the need for initiating treatment without delay for malaria-like illness and reduce instances of 'no treatment' and 'self-treatment'.
- Trained health workforce to deliver EDPT should be assured simultaneous with converting the 'unfelt need' to 'felt need' for diagnosis and treatment.
- Insecticide treatment of bed net should be given utmost priority until ITN can be assured to every household in required number; health education campaign to explain utility of bed net/ITNs in preventing malaria should be strengthened.
- Equity focus in terms of gender and SES should be maintained in every stage of programme implementation.

Malaria prevalence survey

The key findings from the malaria prevalence survey can be summarized as follows:

- For the first time the point prevalence of malaria from 13 malaria endemic districts (3.1%) of Bangladesh is obtained from this study.
- The burden of malaria in five SSE districts (7.2%) is more than the eight NNE districts (0.5%); Malaria is more prevalent in children than the adults.
- Chittagong Hill Tracts (CHT) districts (11%) are the most endemic districts in Bangladesh.
- A large overlooked reservoir of asymptomatic malaria infection was identified in the malaria endemic districts.
- Both *P. falciparum* (2.73%) and *P. vivax* (0.16%) are prevalent in the malaria endemic districts; mixed infection with these two species is 0.19%.
- Not all fever cases are attributable to malaria; RDT detected more malaria cases than the microscopy.

Implications for programme

- Current strategies for the national malaria control programme should be more focused in five SSE districts especially in the Chittagong Hill Tracts districts. Especial emphasis should be given for diagnosis and treatment of malaria in children since they are the most common sufferers.
- Asymptomatic falciparum malaria infection is common in these five SSE districts and the national malaria control programme should take appropriate measures for their treatment.
- Some areas within a District or Thana are more endemic than the other areas of that Thana. So, programmes should take this into consideration while allocating resource (diagnostics and drugs).

Introduction

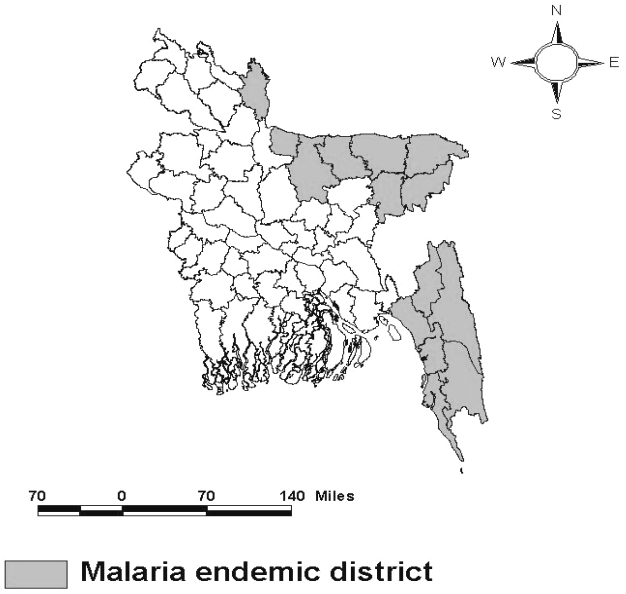
MALARIA: GLOBAL AND NATIONAL PERSPECTIVES

Malaria is a protozoal infection caused by four species of the genus *Plasmodium* (*P vivax, P falciparum, P ovale and P malariae*) and is transmitted by the female Anopheles mosquito, infecting human and insect hosts alternatively. It is a public health problem in some ninety countries worldwide affecting at least 300 million people (Hay *et al.* 2004). Malaria is estimated to be responsible directly for about 1 million deaths annually (or 3000 deaths a day) worldwide (Greenwood *et al.* 2005). Malarial deaths are responsible for almost 3% of the world's DALYs (WHO 2002). While Africa accounts for 90% of the mortality burden for malaria (mostly at homes), South-east Asia accounts for 9% of the burden. Out of 11 countries of the WHO SEARO, 10 countries including Bangladesh are malaria endemic.

Morbidity of malaria comprises severe anaemia (in children and pregnant women), greater prevalence of low birth-weight, and development anomalies from residual effects of cerebral malaria. Besides, irregular attendance at school, impaired intellectual development, reduced productivity etc. are some of its indirect effects (Greenwood *et al.* 2005, Breman *et al.* 2004). The deterioration in malaria control after the '70s is attributed to factors such as climate change, global warming, civil disturbances, international travel, drug and insecticide resistance, and HIV/AIDS (Greenwood *et al.* 2005). Empirical evidence regarding socioeconomic burden of malaria points to the inverse relationship between malarial prosperity and prosperity of the civilization (Sachs and Malaney 2002). There has been a recent resurgence in interest and activities for its prevention, control and research by the international community (Bates and Herrington 2007).

Malaria was nearly eradicated from most of Bangladesh by the 1970's, but never disappeared in the eastern regions associated with tea gardens and forests. It re-emerged as one of the major public health problems in the 1990s (M & PDC, 1997; Sharma, 1996) and remains so (Wijeyaratne *et al.* 2004). Malaria transmission in Bangladesh is mostly seasonal and concentrated in the border regions with Myanmar and India. Out of the total 64 administrative districts, 13 are in the malaria endemic areas and about 98% of the total malaria morbidity and mortality reported from Bangladesh each year originate from these districts (Fig 1). The three Hill Tract Districts Rangamati, Khagrachari, and Bandarban in the very south-east of the country traditionally report the highest incidence of malaria within the country. With a population of 26.9 million, these districts alone have a population bigger than many African nations. Up to 70,000 laboratory-confirmed and 900,000 clinical cases of malaria with more than 500 deaths per year were accounted for in Bangladesh in the late 1990s (WHO, 1999), but these numbers may only represent a gross underestimate of the disease burden because of shortcomings in surveillance and information systems (Bangali *et al.* 2000; Faiz *et al.* 2002). Little is known about the prevalence of malaria in the eight northern and north-eastern districts of the country bordering India. Preliminary observations suggest a considerably lower prevalence of malaria in these eight districts compared to the Chittagong Hill Tracts districts. The 13 malaria endemic districts are shown in Figure 1.

Figure 1. Malaria endemic districts in Bangladesh



POVERTY, MALARIA AND BRAC

The evidence on the link between malaria and poverty is mixed. While Filmer (2002) found no positive correlation between reported fever (as proxy for malaria) and SES in his analysis of DHS data, other studies have contradicted these findings (Worrel *et al.* 2005). However, the poor and the vulnerable populations are disproportionately affected by malaria and severe consequences of malaria is borne more by the poorest (Barat *et al.* 2004). Malaria prevalence exhibits a large negative direct impact on economic performance as well (Gundlach 2004).

There is also strong evidence that use of preventive and treatment interventions for malaria depends upon socio-economic status (SES) (Worral *et al.* 2005, Howard *et al.* 2003, Mutabingwa

2005). The authors found a consistent relationship between use of effective prevention measures such as appropriate drugs, and use and ownership of insecticide treated nets (ITNs) and higher SES. Similarly, access and use of higher level public facilities and private sector practitioners increases with SES, the poor mostly resorting to self-treatment and care-seeking from traditional healers. The economic burden of ill health such as malaria on individual households can be substantial and in some cases catastrophic, especially for the poor households (Russell 2004). Prevention and control of malaria thus can contribute towards poverty alleviation efforts in Bangladesh. But there is dearth of information on these socioeconomic and behavioural aspects of malaria prevention and treatment in Bangladesh.

BRAC, an indigenous micro-credit/microfinance based NGO, is working with the twin objectives of alleviation of poverty and empowerment of the poor, especially women (http://www.brac.net). As part of its efforts to mitigate the income-erosion consequences of illnesses such as malaria for the poor households, BRAC is going to implement a malaria control programme in the 13 malaria-endemic districts funded by the GFATM to reduce burden of malaria (Bangladesh GFATM round 6 proposal). This will be a collaborative project between the BRAC-led NGO consortium and the Malaria and Parasitic Disease Control (M & PDC) Programme of the Government of Bangladesh. The programme will have both preventive (distribution of ITNs, intermittent insecticide spray and awareness building programmes) and curative (presumptive case management, early diagnosis and prompt treatment following WHO guidelines, and referral of complicated cases to tertiary facilities) interventions. The interventions will be implemented as a part of larger BRAC Health Programme's Essential Health Care (EHC) intervention (BRAC 2006, BHP 2006).

This study aims to record benchmark information on the prevalence of malaria infection and relevant information on malaria knowledge and awareness, health-seeking behaviour, use of bed nets and their socioeconomic differentials in the community before the launching of the malaria control interventions. The data generated is expected to fill in the knowledge gaps in social science aspects of malaria in Bangladesh and help programme to develop informed intervention components and strategies (by BRAC and other NGOs), and also, future programme evaluation and impact assessment (Breman *et al.* 2004).

OBJECTIVES OF THE BASELINE SURVEY

The baseline survey aimed to study:

i) the knowledge/awareness of the respondents on malaria

ii) their health-seeking behaviour relevant to malaria

iii) study the possession and use patterns of bed net

iv) the prevalence of malarial infection including species-specific prevalence (*P vivax and P falciparum*) and its distribution

This report present findings from this baseline survey to inform programme design and fine-tune appropriate interventions.

Materials and Methods

STUDY AREA

The population of Bangladesh according to the 2001 census was 129,247, 233 divided into six divisions and 64 districts. Malaria is endemic in 13 districts comprising a population of 26.9 million as per 2001 census. The 13 Malaria endemic districts of Bangladesh are the following:

i) South and South-eastern area (henceforth SSE area): Chittagong, Cox's Bazar, Khagrachari, Rangamati, Bandarban (total 5 districts)

ii) Northern and North-eastern area (henceforth NNE area): Kurigram, Sherpur, Mymensingh, Netrokona, Sunamgonj, Sylhet, Moulvibazar, Habiganj (total 8 districts)

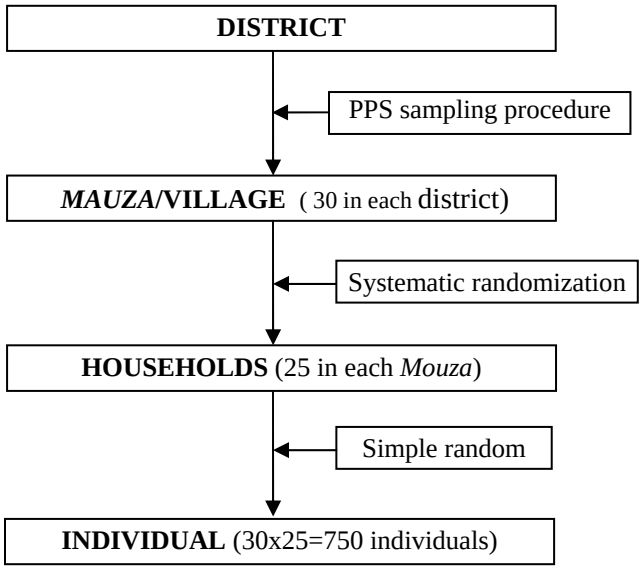
The districts are composed of *upazilas* divided into Unions, the latter again divided into *Mauzas*/ *Mahallas*.

SAMPLING STRATEGY

Two-stage cluster sampling technique was employed using population figures from the 2001 census. City Corporations and towns were excluded from this survey. For each of the 13 districts, all *mauzas* were listed and 30 *mauzas* were selected using a probability proportional to size (PPS) sampling procedure (Larson *et al.* 2006). Information from the Bangladesh Bureau of Statistics was utilized to obtain the sampling frame for selection of the *mauzas* in each district. These *mauzas* were the primary sampling unit. Twenty-five households were selected using systematic random sampling from each mauza/cluster (Figure 1). All population above the age of one year irrespective of sex, religion, ethnicity in a cluster were eligible to participate in the prevalence survey. For this purpose, one member (age>1 year) from each household was randomly chosen.

Socioeconomic questionnaire was administered to the participant (if adult) or a knowledgeable member (usually the head or spouse) of the selected household.

Figure 2. Sampling design



Sample size calculation

There is no published malaria prevalence data from Bangladesh. However, there are published malaria prevalence data from other Asian countries such as Cambodia. The lowest malaria prevalence found in some areas of Cambodia is 3% (Incardona *et al.* 2007). We expect that the malaria prevalence in our low endemic districts would be around 2%, while in the high endemic districts it would be more than 3%.

Given the design of the study as a cluster survey, the sample size had to incorporate the design effect (Bennet *et al.* 1991). Sample size is calculated using a web-based software C-Survey 2.0 based on the conservative estimates of malaria prevalence and design effect. Sample size was estimated assuming the lowest estimate of malaria prevalence at 2% a precision of 1.5%, at 95% confidence interval with a design effect 2. Thus, 750 individuals from 750 households will be required in each district for this study. This will give us a total sample size of approximately 9,750 individuals in all 13 malaria endemic districts. It was assumed that this sample would also be enough to have an adequate estimation of the population parameters on socioeconomic status, care seeking in malaria and use of bed nets.

THE SURVEY

The malaria prevalence and socioeconomic survey was conducted during July to November 2007 to cover the peak malaria season in Bangladesh. The survey commenced in the five south/south-eastern districts and then moved on to the eight north/north-eastern districts.

Tools development

A structured questionnaire was developed to collect all relevant information from study participants. The first part of the questionnaire collected information on demographic characteristics including awareness of malaria and health-seeking behaviour, and information on bed nets. The second part collected information on household socioeconomic characteristics and general health awareness including self-reported health. The questionnaires were pre-tested in a village outside our sample for ascertaining consistency, appropriateness of languages, sequencing of the questions, and to have an insight into the field operation procedure. The questionnaire was finalized after feedback from field testing.

Recruitment, training and deployment of the interviewers

The survey team comprised of experience interviewers and their supervisors. In hilly areas interviewers from ethnic groups were recruited to interview respective ethnic group of people. A five-day intensive training was organized for the interviewers consisted of didactic lectures, mock interviews, role play and field practice at community level. Several teams worked in parallel in each district. Each team typically consisted of 4-5 members including one person trained in malaria microscopy. He was given training on sterile blood sampling techniques, slide preparation, and the handling of rapid diagnostic test (RDT). The training was organized by BRAC in collaboration with ICDDR,B and Medical University of Vienna, Austria prior to the commencement of the survey.

Field operation

Prior to the actual survey, teams of interviewers, each led by an experienced supervisor, were deployed in study *mouzas*/villages about one or two days before beginning of the survey for rapport building activities. During this time the villagers were informed about the purpose and activities of the survey and their cooperation was sought.

In each *mauza*/village, the study team drew a map. Households were then chosen through a systematic random sampling process. The field teams selected every third household encountered as they moved from the centre or periphery of the *mauza*/village following a designated path using the “spin the bottle” methodology (Sintasath *et al.* 2005).

All member of the household including absentees were listed. Only one individual (>1 year) from a household was enrolled into this study using a simple randomization procedure. Informed consent was obtained before proceeding with the survey activities. Selected individuals were tested for malaria and information collected for any febrile illness in the past 15 days. One team member drew one drop of blood by finger prick sampling for the malaria RDTs (Rapid Diagnostic Tests), one drop for the microscopy slide preparation, and two drops of blood for the PCR filter paper (total four drops of finger prick blood). RDT results were recorded on the results sheet and in a logbook. Patients diagnosed as having malaria were referred to BRAC for treatment as per national guideline. In case an absent member of the household is selected by randomisation, effort was be made to collect his/her blood at a later time when the person was at home. In addition to screening one member per household for malaria parasites, the field team administered the survey questionnaire to the participant (if adult) or a knowledgeable adult member of the family in a face-to-face interview for collecting required information. If there was no respondent present or if the respondent refused to take part in the survey, the teams substituted it with an adjacent household. Households were visited on three repeated occasions at intervals,

if the first attempt was not successful due to absence of the respondents. When these repeated attempts failed, the interview was called-off for the particular household.

The day-to-day field activities of the teams were fine-tuned by field researchers based in local offices. The investigators from central office at Dhaka made frequent field visits for spot checking the quality of interviews and providing assistance and guidance when needed. Whenever necessary, re-interview was done by the supervisors for securing reliable and valid data.

Quality control

Efforts to improve the reliability and validity of data reporting included the use of culturally appropriate language, limiting the recall period of illness to 15 days, and deploying an independent quality control team to spot-check households randomly within three days of the main survey. In cases where inconsistencies were noted, interviewers were accompanied by field supervisors until quality standards were met. Both prior to and during the survey, all interviewers received rigorous training on questionnaire content, probing techniques and strategies to establish rapport and neutrality essential to complete an accurate data collection.

Each completed questionnaire was scrutinized in the field and at the field office on the same day of interview. Further scrutiny occurred at the Dhaka Head Office when data were cleaned and coded. Range and internal consistency checks were performed before entering data in computer. Fox Pro was used for data entry and SPSS ver 10 was used for data analysis. A preliminary data analysis plan was developed in keeping with the objectives of the study. In this report, data are presented in univariate and bivariate tables with frequencies and percentages.

MALARIA DIAGNOSIS

Malaria was diagnosed by Rapid Diagnostic Tests (RDT) based on the detection of *P. falciparum*-specific antigen and *Plasmodium vivax*-specific antigen. The trade name of this RDT is "FalciVax" and it is being produced by Zephyr Biomedicals, India (www.tulipgroup.com). The cost is around 2 US dollar. Each FalciVax is rapid self-performing, qualitative, two site sandwich immunoassay utilizing whole blood for the detection of *P. falciparum* specific histidine rich protein-2 (Pf, HRP-2) and *P. vivax* specific pLDH. The test can be used for specific detection and differentiation of *P. falciparum* and *P. vivax* malaria. The standardization of this test has already been done by the Zephyr Biomedicals. Sensitivity of the RDT is similar to that commonly achieved by good field microscopy. Sensitivity and specificity of the RDT used for the detection of *P. falciparum* and *P. vivax* is more than 95% and now been recommended for use in the malaria control programme by the WHO (Singh *et al.* 2002; Moody 2002; WHO 2004) and now being adopted by the national malaraia control programme to use at community level under revised malaria control strategy.

Quality control of RDTs.

Quality control was done by microscopy on all positive (according to RDTs) and randomly selected 2 % negative slides at the field site. Slides were brought back to Parasitology Laboratory of ICDDR,B for re-checking. Additional quality control, particularly for potential cases of mixed infections, was provided by PCR. All slides that were stained were retained for later review. Blood spots and samples for PCR examination was similarly retained in appropriate conditions. As with paper records, samples were clearly identified and stored securely with strict conditions for access.

Blood film

Both thick and thin films were done for diagnosis of malaria by microscopy. The blood films were stained with 15 Giemsa stain in phosphate buffer saline and examined under the microscope at a magnification of x 1,000 for the presence of malaria parasites. Blood films were defined as negative if no parasite were observed in 300 oil imerssion fields (magnification, x 1000) on thin film by an experienced microscopist (Warhusrt and William 1996).

PCR

Blood DNA was extracted from the filter paper blood using Qiagen's blood DNA extraction kit as per manufacturer's protocol. Purified DNA template was used for amplification in a DNA thermal cycler using a *P. falciparum* specific primers (Perandin *et al.* 2004).

GEOGRAPHICAL DATA

For this malaria survey 390 *mauzas* were selected Garmin eTrex Venture handheld GPS were used to collect the locations of survey sites. GPS data were downloaded with data download cable. *Thana* level polygon boundary map was used to cross check the study sites. GPS points were superimposed on the polygon boundary and verified accuracy. Arc GIS 9.1 software was used for developing choropleth map. Districts, regional and national level figures were produced from malaria prevalence data.

Results from Socioeconomic Survey

In this baseline survey, a total of 9,749 households were visited which had a total population of 50,809. One respondent from one household was randomly chosen (N=9,749) for the structured interview and screening for malarial parasite through rapid diagnostic test. Of these, 3,750 were from SSE districts and 5,999 were from NNE districts. The results begin with a brief profile of the socio-demographic and economic characteristics of the study population and their households, which is followed by key findings on self-perceived health, general health and malaria awareness, health-seeking behavior for malaria, and possession and use of bednets.

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

The socio-demographic characteristics of the study population are presented in Table 1 by the two study areas. Majority of the respondents were in their prime years. Around 50% of the respondents were illiterate in both areas while greater proportion of population in SSE area (30%) had more than five years of schooling compared to NNE area (21%). Around 91% of the respondents were currently married, irrespective of the study areas. Main occupation for the respondents was agriculture for the males (60-70%) and household chores for the females (around 65%), in both the areas. No major difference was seen in case of self-employment between the two areas. On the other hand, earning livelihood from wage-labour was reported more in the NNE area (16.5%) compared to the other area (10%). Service with fixed salary was more frequently reported from SSE area (10%) than the other area (7%).

Table 1. Socio-demographic characteristics of the study population by study areas (%)

	South/South-eastern districts			North/North-eastern districts		
	M	F	All	M	F	All
Age (yrs)						
≤19	0.1	0.8	0.2	0.5	0.2	0.5
20-39	38.9	25.4	38.0	35.5	24.8	34.8
40-59	43.7	53.2	44.4	45.3	54.9	45.9
≥60	17.2	20.6	17.5	18.8	20.1	18.9
Marital status						
Never married	3.0	3.2	3.0	2.6	0.2	2.5
Currently married	95.7	27.0	91.0	96.0	17.9	90.7
Others[1]	1.3	69.8	5.9	1.3	81.9	6.8
Formal schooling years						
None	42.8	69.4	44.6	53.6	75.2	55.1
1-5	25.7	17.9	25.2	24.9	17.6	24.4
>5	31.6	12.7	30.3	21.5	7.1	20.6
Occupation						
Self-employment (agri.)	45.8	11.1	43.4	42.7	2.9	40.0
Self-employment (non-agri.)	23.0	3.2	21.6	21.9	2.9	20.6
Wage-labour	10.2	9.9	10.2	17.0	8.8	16.5
Service	10.6	4.8	10.2	7.4	2.9	7.1
Domestic chores	0.7	61.5	4.8	1.1	69.9	5.8
Others[2]	9.7	9.5	9.7	9.8	12.5	10.0
N	3498	252	3750	5548	408	5999

HOUSEHOLD ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Findings revealed that the households from SSE area fared better than the other area in term of land-holdings, self-rated poverty status and poverty transition (Table 2). These households from SSE had more land (41% having 100+ decimals of land), were more food-secured (52% households self-rated as non-deficit) and poverty transition was better (improvement reported by 25% of households annually). However, when stratified in terms of asset quintiles (based on productive assets of the households), the proportion of poorest households were found to be greater in the SSE area compared to the NNE area.

[1] widowed, divorced, abandoned etc.
[2] beggar, unemployed, too old/sick to work etc.

Table 2. Household economic characteristics of the respondents by study areas

	South/South-eastern districts		North/North-eastern districts	
	No	%	No	%
Household headship				
Male	3499	93.3	5592	93.2
Female	251	6.7	407	6.8
Household's land holdings				
<10	781	20.8	1404	23.4
10-49	922	24.6	1653	27.6
50-100	491	13.1	819	13.7
100+	1556	41.5	2123	35.4
Self-rated poverty status				
Always deficit	571	15.2	1430	23.8
Occasional deficit	1217	32.5	1891	31.5
Break-even/No deficit	1962	52.3	2678	44.6
Perceived change in economic condition in last one year				
Improved since last year	937	25.0	1160	19.3
No change	2008	53.5	3100	51.7
Deteriorated since last year	805	21.5	1739	29.0
Wealth index				
Poorest	884	23.6	1082	18.0
2	798	21.3	1297	21.6
3	680	18.1	1108	18.5
4	737	19.7	1218	20.3
Least poor	651	17.4	1294	21.6
N	3750	100	5999	100

GENERAL HEALTH AWARENESS

The respondents were found to be well aware about general health issues such as sanitation (80-90%), hand washing at critical time (85-90%), water-borne diseases (90+%) and how to purify water (85-90%) (Table 3). However, the knowledge about how water becomes contaminated appeared to be marginal (around 9%). When asked about how to maintain good health, the three most frequent responses given were: regular intake of nutritious food (around 87%), maintain neat and cleanliness (around 60%), and at a much lower level, taking bath regularly (around 20%). No major difference was observed between areas or sexes in these aspects. Lastly, we probed whether they were knowledgeable about locally available healthcare facilities. Interestingly, the five major facilities/providers cited were: *Upazila* Health Complex (UHC, around 70%) [but only around 4% for much closer *Union* Health and Family Welfare Centre (UHFWC)], Drug shops (around 55%), Traditional healer/village doctor (around 37%), private MBBS doctor (20%), and private clinic (around 15%).

Table 3. General health awareness of the respondents by study areas %

	South/South-eastern districts			North/North-eastern districts		
	M	F	All	M	F	All
Knows about rules to be followed for maintaining good health*						
Regular intake of nutritious food	81.2	84.1	81.4	90.2	88.7	90.1
Regular bathing	22.4	19.9	22.2	21.9	18.6	21.7
Trimming nails regularly	2.9	4.0	3.0	3.4	3.7	3.5
Regular light exercise	6.8	3.2	6.6	8.9	7.8	8.9
Maintain neatness and cleanliness	61.6	60.6	61.5	63.4	60.5	63.2
All of the above	0.1	0.4	0.1	0.1	0.2	0.1
Don't know	8.4	7.6	8.3	4.0	5.9	4.2
Others	2.4	1.6	2.3	1.2	0.5	1.1
Knows about sanitary latrine	88.3	88.0	88.3	94.7	92.6	94.6
Knows about hand washing with ash/soap after returning from latrine	86.1	83.7	86.0	90.1	89.4	90.0
Knows that water is contaminated when dirty hands come in contact with water	8.6	8.4	8.6	10.5	10.5	10.5
Knows about water-borne diseases	90.2	88.4	90.1	96.1	94.9	96.0
Knows how water can be purified	83.9	82.5	83.8	91.7	88.7	91.5
Knowledge on health facilities/health providers available locally*						
Community health workers/volunteers	7.0	2.0	6.7	0.4	0.2	0.4
UHFWC	6.6	5.2	6.5	4.7	2.9	4.5
UHC	65.1	66.5	65.2	68.8	75.2	69.3
Medical College Hospital	1.9	2.0	1.9	3.1	2.2	3.1
Sadar Hospital	11.7	8.4	11.5	13.0	9.3	12.8
BRAC Health Centre	2.0	2.0	2.0	0.1	0.0	0.1
Private health centre/clinic	18.3	15.9	18.1	16.0	12.0	15.7
Drug shops	59.0	64.1	59.3	53.6	47.8	53.2
Private MBBS doctor	22.7	26.3	22.9	20.1	15.7	19.8
Traditional healers/RMP	33.1	32.3	33.0	43.1	39.2	42.8
Homeopath	2.1	2.0	2.1	2.0	2.2	2.0
Don't know	0.3	0.4	0.3	0.0	0.2	0.1
Others	0.9	0.0	0.9	0.0	0.0	0.0
N	3499	251	3750	5591	408	5999

*multiple responses

Except for UHC in the NNE area, women were marginally less knowledgeable about the facilities/providers compared to men, in both areas.

MALARIA AWARENESS AND KNOWLEDGE

Cause and transmission

The respondents' awareness about malarial illness as well as its cause (mosquito bite) was almost universal (>90%) (Table 4). However, when they were asked about its mode of transmission, only around 40% in the SSE area and 33% in the NNE area could respond correctly ('by bite of mosquito which has bitten a malarial patient'). The women in SSE area trailed behind the men in this knowledge. This knowledge on cause and transmission of malaria increased uniformly with years of schooling, as well as level of asset quintiles.

Symptoms

Majority of the respondents (78% in SSE area and 84% in NNE area) reported 'onset of fever with shivering' as the most common symptom of malaria (Table 5). Education and asset was found to have a direct relationship with the level of knowledge regarding malarial symptoms.

Prevention

Interestingly, use of bednet for prevention of malaria was singled out uniformly by the respondents (>80%, but ITN only around 2%) (Table 6). Other measures reported were: preventing breeding of mosquito (13% in SSE area and 18% in NNE area), using mosquito repellant/coil (16% in SSE area and 20% in NNE area). Not much variation was seen by sex, but the trend observed earlier with education and asset remained.

Treatment and place of seeking treatment

The respondents almost unanimously reported allopathic medicine to be the treatment for malaria (>98%) without variation by sex, area, education or asset (Table 7). When asked about where they would go for seeking treatment, distinct differences were noted between the areas. Three most frequently mentioned places/providers by respondents in SSE area were, in order of frequency: public health facilities (60%), drugstore sales people (40%) and village doctors (33%). In case of NNE area, these were: public health facilities (72%), village doctors (42%) and drugstore sales people (23%). Private facilities were more frequently mentioned by respondents from SSE area (24%) than from NNE area (18%).

Table 4. Awareness, causes and mode of transmission of malaria by study areas, sex, years of schooling and wealth quintiles % (multiple responses)

	South/South-eastern districts			North/North-eastern districts		
	Sex					
	M	F	All	M	F	All
Have heard about malaria	97.2	96.8	97.2	99.1	98.5	99.1
Causes of malaria						
Mosquito bite	93.5	91.4	93.4	95.4	94.0	95.3
Fly/insect bite	4.9	4.1	4.9	2.0	1.8	2.0
Not maintaining neat and cleanliness	6.1	3.3	5.9	5.0	4.0	4.9
Others	5.5	6.9	5.6	3.6	4.3	3.6
Mode of transmission						
By bite of any mosquito	34.6	37.8	34.8	33.3	36.5	33.5
By bite of mosquito which has bitten a malarial patient	40.7	31.1	40.0	32.8	32.3	32.8
Don't know	25.3	29.5	25.6	30.9	28.0	30.7
Other	3.2	3.7	3.2	7.0	7.4	7.0
N	3499	251	3750	5591	408	5999
	Years of schooling					
	None	1-5	>5	None	1-5	>5
Have heard about malaria	95.8	97.1	99.3	98.7	99.2	99.8
Causes of malaria						
Mosquito bite	91.1	94.3	95.8	94.3	96.0	97.1
Fly/insect bite	4.7	4.6	5.3	1.6	1.9	3.1
Not maintaining neat and cleanliness	4.5	6.5	7.4	5.1	3.3	6.2
Others	7.4	4.6	3.8	4.5	3.1	1.9
Mode of transmission						
By bite of any mosquito	36.9	38.5	28.9	33.5	36.1	30.2
By bite of mosquito which has bitten a malarial patient	30.8	40.2	53.0	28.1	28.8	50.1
Don't know	30.8	21.9	21.2	33.9	32.2	20.3
Other	3.4	3.2	3.1	7.8	6.3	5.7
N	1683	938	1129	3322	1453	1224
	Wealth Quintiles					
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
Have heard about malaria	94.7	96.8	99.4	98.2	99.1	99.7
Causes of malaria						
Mosquito bite	89.7	93.5	96.1	93.8	94.2	97.5
Fly/insect bite	4.9	5.2	6.5	0.8	1.6	4.4
Not maintaining neat and cleanliness	5.1	5.3	6.3	3.7	5.0	5.3
Others	8.5	5.5	3.4	5.1	4.4	1.6
Mode of transmission						
By bite of any mosquito	33.0	34.7	39.9	30.5	30.5	38.7
By bite of mosquito which has bitten a malarial patient	32.8	41.7	43.7	24.1	31.2	43.9
Don't know	33.3	23.8	18.9	40.1	32.4	19.4
Other	2.1	4.1	3.7	6.5	9.8	5.0
N	884	680	647	1082	1108	1294

Source of information

Neighbors and relatives were the most frequently mentioned group for malaria-related information (36% in SSE and 49% in NNE areas respectively) by the respondents (Table 8). However, with increasing level of schooling and asset ownership, the proportion decreased gradually to be replaced by community health workers from government and NGOs. Mass media (Radio/TV/Newspaper) and printing media (poster/leaflet) became increasingly important means of message dissemination with increasing level of education and asset.

Table 5. Symptoms of malaria by study areas, sex, years of schooling and wealth quintiles % (multiple responses)

	South/South-eastern districts			North/North-eastern districts		
	Sex					
	M	F	All	M	F	All
Symptoms of malaria						
Onset of fever with shivering	78.6	74.2	78.3	84.0	82.3	83.9
Fever at intervals	20.4	23.0	20.6	25.9	28.1	26.0
Remission of fever with sweating	10.8	7.8	10.6	16.1	15.4	16.1
Others	19.0	19.3	19.0	10.4	8.7	10.3
N	3499	251	3750	5591	408	5999
	Years of schooling					
	None	1-5	>5	None	1-5	>5
Symptoms of malaria						
Onset of fever with shivering	75.0	79.3	82.2	81.1	85.6	89.2
Fever at intervals	20.0	18.9	22.7	27.1	22.9	26.8
Remission of fever with sweating	8.7	11.9	12.2	15.2	13.7	21.3
Others	19.3	18.1	19.4	11.0	9.4	9.3
N	1683	938	1129	3322	1453	1224
	Wealth Quintiles					
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
Symptoms of malaria						
Onset of fever with shivering	72.4	79.2	83.6	77.9	85.9	87.0
Fever at intervals	18.6	21.2	21.2	26.2	21.9	32.3
Remission of fever with sweating	8.4	10.9	13.5	10.3	16.8	22.7
Others	23.2	18.4	16.3	12.9	9.1	9.9
N	884	680	647	1082	1108	1294

Table 6. Prevention of malaria by study areas, sex, years of schooling and wealth quintiles % (multiple responses)

	South/South-eastern districts			North/North-eastern districts		
	Sex					
	M	F	All	M	F	All
Mode of prevention						
Preventing breeding of mosquito	13.7	6.9	13.2	17.8	18.9	17.9
Using bednet	86.5	85.3	86.4	85.1	81.9	84.9
Using insecticide impregnated bednet	1.1	0.8	1.0	2.1	2.7	2.2
Using mosquito repellent/coil	16.6	13.5	16.4	20.1	21.1	20.2
Other	12.7	15.5	12.9	9.5	10.7	9.6
N	3499	251	3750	5591	408	5999
	Years of schooling					
	None	1-5	>5	None	1-5	>5
Mode of prevention						
Preventing breeding of mosquito	8.2	13.3	20.4	17.1	14.1	24.5
Using bednet	84.4	86.8	89.0	82.6	86.0	90.0
Using insecticide impregnated bednet	0.8	1.1	1.3	1.6	2.6	3.0
Using mosquito repellent/coil	11.7	17.5	22.3	15.8	21.8	30.1
Other	14.8	12.7	10.3	10.9	9.1	6.5
N	1683	938	1129	3322	1453	1224
	Wealth Quintiles					
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
Mode of prevention						
Preventing breeding of mosquito	7.2	13.5	18.0	9.0	18.0	26.5
Using bednet	80.5	87.1	90.0	86.0	81.2	87.4
Using insecticide impregnated bednet	0.7	1.5	1.2	0.9	2.7	2.3
Using mosquito repellent/coil	8.5	16.1	24.8	13.4	16.6	32.7
Other	17.8	12.9	8.8	10.2	12.0	7.1
N	884	680	647	1082	1108	1294

Table 7. Treatment of malaria and place of seeking treatment by study areas, sex, years of schooling and wealth quintiles % (multiple responses)

	South/South-eastern districts			North/North-eastern districts		
	Sex					
	M	F	All	M	F	All
Mode of treatment						
Allopathic treatment	98.6	98.8	98.7	99.4	98.5	99.3
Traditional (Herbal/*Kabiraji*)	1.8	1.2	1.7	1.1	2.0	1.1
Faith healing	0.6	0.0	0.5	0.3	0.2	0.3
Homeopathic	0.5	0.0	0.4	0.3	0.2	0.3
Other	0.8	1.2	0.8	0.2	0.5	0.2
Place of seeking treatment						
Public hospital/health centres	60.4	55.5	60.1	72.2	76.2	72.4
Private health centres	24.6	22.0	24.5	18.6	15.1	18.3
Village doctors	33.7	33.9	33.7	42.0	39.0	41.8
Drug store sales people	39.3	41.2	39.4	23.5	20.3	23.3
Other	1.6	1.2	1.6	0.5	0.5	0.5
N	3499	251	3750	5591	408	5999
	Years of schooling					
	None	1-5	>5	None	1-5	>5
Mode of treatment						
Allopathic treatment	98.1	99.0	99.1	99.3	99.4	99.5
Traditional (Herbal/*Kabiraji*)	2.1	1.4	1.4	1.0	1.5	1.1
Faith healing	0.5	0.5	0.5	0.2	0.3	0.3
Homeopathic	0.6	0.4	0.3	0.2	0.3	0.6
Other	1.2	0.8	0.4	0.3	0.1	0.0
Place of seeking treatment						
Public hospital/health centres	53.3	61.6	68.7	68.1	73.2	83.4
Private health centres	22.2	24.2	28.0	16.8	19.2	21.5
Village doctors	33.5	35.4	32.6	44.5	38.4	38.6
Drug store sales people	42.3	40.7	34.3	25.3	22.3	19.0
Other	2.1	1.6	0.9	0.7	0.4	0.1
N	1683	938	1129	3322	1453	1224
	Wealth Quintiles					
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
Mode of treatment						
Allopathic treatment	98.0	98.6	99.5	99.0	99.5	99.4
Traditional (Herbal/*Kabiraji*)	2.5	1.7	1.7	1.2	1.0	1.2
Faith healing	0.2	0.6	0.6	0.2	0.2	0.4
Homeopathic	0.2	0.2	0.5	0.1	0.2	0.5
Other	1.6	0.6	0.0	0.7	0.0	0.0
Place of seeking treatment						
Public hospital/health centres	51.7	61.2	70.6	59.5	71.6	86.9
Private health centres	20.0	25.8	28.9	13.0	17.7	21.8
Village doctors	31.3	35.7	35.5	49.3	39.0	35.9
Drug store sales people	49.0	38.8	28.4	36.9	21.9	15.6
Other	2.9	1.1	0.6	0.9	0.5	0.1
N	884	680	647	1082	1108	1294

Table 8. Source of malaria-related information by study areas, sex, years of schooling and wealth quintiles % (multiple responses)

	South/South-eastern districts			North/North-eastern districts		
	Sex					
	M	F	All	M	F	All
Source of information						
Govt. health worker	21.9	13.8	21.3	25.3	23.8	25.2
NGO health worker	27.7	19.1	27.1	16.8	14.4	16.7
Radio/TV/Newspaper	15.0	15.9	15.0	15.3	13.2	15.2
Poster/leaflet	2.5	5.7	2.7	2.0	3.2	2.0
Neighbours/relatives	35.9	44.7	36.5	48.7	57.8	49.3
Self	16.5	14.2	16.3	14.8	9.7	14.5
Other	2.9	6.1	5.9	4.2	4.2	4.2
N	3499	251	3750	5591	408	5999
	Years of schooling					
	None	1-5	>5	None	1-5	>5
Source of information						
Govt. health worker	18.6	20.5	25.9	22.9	23.7	33.0
NGO health worker	24.6	26.7	31.1	15.0	17.1	20.6
Radio/TV/Newspaper	9.8	17.0	21.1	12.3	13.5	24.8
Poster/leaflet	1.6	2.9	4.2	2.1	1.1	2.9
Neighbours/relatives	43.3	36.8	26.2	55.5	48.8	33.3
Self	13.8	16.5	19.8	12.2	16.6	18.0
Other	6.7	6.7	4.1	4.5	4.6	3.3
N	1683	938	1129	3322	1453	1224
	Wealth Quintiles					
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
Source of information						
Govt. health worker	18.8	22.4	22.3	28.6	22.6	26.3
NGO health worker	25.3	30.8	19.7	14.6	17.7	16.8
Radio/TV/Newspaper	5.6	14.0	32.7	4.1	10.6	31.8
Poster/leaflet	1.0	1.8	7.0	0.3	2.1	2.7
Neighbours/relatives	46.6	36.3	28.3	51.5	54.4	38.2
Self	13.2	15.6	21.5	13.5	14.0	18.4
Other	5.5	7.0	5.4	6.6	3.8	3.6
N	884	680	647	1082	1108	1294

BEDNET POSSESSION AND ITS USE

The overwhelming majority of the households (>93%) in both areas possessed at least one bed-net though only a microscopic fraction was treated with insecticides in the past six months prior to survey (Table 9). The least poor (rich) households possessed about two-and-half times more bednets than the poorest households in the SSE area, and about three times more in the NNE area (Table 9). The percentage of bednets treated with insecticides increased from 2% in the poorest households to 5% in the least poor (rich) households in the SSE area, but the proportion was altogether negligible in the NNE area.

No difference by sex or area was observed in no. of individuals sleeping under the bednet in the night before the survey. No. of members regularly sleeping under bednet increased with increasing level of asset, plausibly so because better asset level was also associated with greater number of bednets.

PREVALENCE AND HEALTH-SEEKING BEHAVIOUR OF MALARIA-LIKE ILLNESS

Around 2% of the respondents in SSE area and 0.4% respondents in NNE area reported to have had suffered from fever with shivering within 15 days prior to the day of survey. No sex difference in fever prevalence was seen (Table 10).

Next, we elicited information on health-seeking behaviour of those respondents who had a fever with shivering within past 15 days prior to the day of survey. Majority of the ill persons did not seek any treatment, women more so than men and those from SSE area more so than those in the NNE area (Table 11). Self-treatment was practiced more frequently by ill persons from NNE area (14%) than by those from SSE area (11%). Professional allopathic practitioners were consulted in 13% of instances in both areas, with a gender gradient disfavoring women. On the other hand, drugstore salespeople were consulted more frequently by those from the SSE area (47%) compared to the NNE area (32%), with marginal or no gender difference. When disaggregated by level of education and assets, the same general trend as noted above (e.g., decrease in no-treatment/self-treatment, increased treatment seeking from professionals etc. with more education and better asset quintiles) was observed.

Table 9. Information on bednets by study areas and wealth quintiles

	South/South-eastern districts	North/North-eastern districts
No. of bed- net per household (mean)	2.7 ± 1.5	2.2 ± 1.3
% HHs with at least one bed- net	94.7	93.3
% HHs with bednet treated with insecticide in last six months	4.2	0.2
No. of HH members who slept under bednet yesterday (mean±sd)	5.0 ± 1.9	4.9 ± 2.0
No. of under-five children who slept under bednet yesterday (mean±sd)	1.5 ± 1.1	1.3±0.5
No. of pregnant women who slept under bednet yesterday (mean±sd)	1.0 ± 0.2	1.0 ± 0.21
N	3750	5999

	Wealth Quintiles					
	South/South-eastern districts			North/North-eastern districts		
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
No. of bed- net per household (mean)	1.6 ± 1.1	2.7 ± 1.2	3.9 ± 1.7	1.23 ± 0.9	2.1±1.0	3.3±1.4
% HHs with at least one bednet	85.4	96.8	99.4	76.1	96.1	99.5
% HHs with bednet treated with insecticide in last six months	2.1	4.9	5.1	0.1	0.2	0.2
No. of HH members who slept under bednet yesterday (mean±sd)	4.4 ± 1.7	5.0 ± 1.8	5.7 ± 2.2	4.1 ± 1.7	4.8 ± 1.9	5.5 ± 2.3
No. of under-five children who slept under bednet yesterday	1.4 ± 0.8	1.5 ± 1.2	1.5 ± 1.2	1.3 ± 0.5	1.3 ± 0.5	1.3 ± 0.5
No. of pregnant women who slept under bednet yesterday	1.0 ± 0.2	1.0 ± 0.2	1.1 ± 0.3	1.1 ± 0.3	1.0 ± 0.1	1.0 ± 0.2
N	884	680	651	1082	1108	1294

Table 10. Prevalence of fever with shivering in past 15 days prior to survey %

	South/South-eastern districts			North/North-eastern districts		
	M	F	All	M	F	All
Had fever with shivering in last 15 days	1.7	2.0	1.8	0.5	0.4	0.4
N	10147	9675	19822	16025	14962	30987

Table 11. Health-seeking behaviour of the study population with fever and shivering by study areas, sex, years of schooling and wealth quintiles %

	South/South-eastern districts			North/North-eastern districts		
	M	F	All	M	F	All
No treatment	35.8	41.3	38.7	20.5	25.4	22.7
Self-treatment	10.4	11.1	10.8	15.1	11.9	13.6
Drug store salespeople	35.3	29.6	32.3	45.2	49.2	47.0
Paraprofessionals	2.3	4.8	3.6	2.7	3.4	3.0
Professional allopaths (MBBS doctors)	14.5	11.6	13.0	16.4	8.5	12.9
Others	1.7	1.6	1.7	0.0	1.7	0.8
N	173	189	362	73	59	132
	Years of schooling					
	None	1-5	>5	None	1-5	>5
No treatment	39.1	41.1	28.8	20.7	26.3	10.0
Self-treatment	12.8	7.5	15.3	10.3	13.2	25.0
Drug store salespeople	33.8	31.8	32.2	55.2	39.5	35.0
Paraprofessionals	4.5	1.9	5.1	0.0	5.3	10.0
Professional allopaths (MBBS doctors)	9.0	15.9	16.9	12.1	15.8	20.0
Others	0.8	1.9	1.7	1.7	0.0	0.0
N	133	107	59	58	38	20
	Wealth Quintiles					
	South/South-eastern districts			North/North-eastern districts		
	Poorest	3rd Quintile	Least poor	Poorest	3rd Quintile	Least poor
No treatment	47.2	30.6	27.6	29.2	28.6	16.0
Self-treatment	10.4	14.5	10.3	16.7	14.3	24.0
Drug store salespeople	26.4	30.6	37.9	37.5	52.4	36.0
Paraprofessionals	3.2	6.5	3.4	0.0	0.0	0.0
Professional allopaths (MBBS doctors)	11.2	12.9	17.2	12.5	4.8	24.0
Others	1.6	4.8	3.4	4.2	0.0	0.0
N	125	62	29	24	21	25

Finally, Table 12 shows time to treatment initiation, duration of illness, disruption of income-earning and cost of treatment. In the SSE area, treatment was initiated within 24 hours much more frequently (43%) than in the NNE area (26%). In the SSE area, majority of the episodes of illness were of 4 to 7 days duration (43%) while in the NNE area, the episodes lasted for 7 or more days (47%) in majority of instances. In the NNE area, ill persons experienced disruption of income-earning for around 8 days compared to 5 days for those from SSE area.

Mean total expenditure on illness incurred in last 15 days due to malaria-like illness was more in the NNE area (Tk. 343) than in the SSE area (Tk. 213). In both areas, expenditure was more for men than women. Of the different costs, expenditure on drugs was the major component.

Table 12. Time to treatment initiation, duration, disruption of income-earning and illness expenditure by study areas and sex

	South/South-Eastern districts			North/North-Eastern districts		
	M	F	All	M	F	All
Treatment initiated						
Within 24 hours	44.8	41.7	43.2	24.6	27.3	25.7
Beyond 24 hours	55.2	58.3	56.8	75.4	72.7	74.3
Duration of illness						
≤ 3 days	29.1	33.9	31.7	19.6	21.9	20.5
4-7 days	50.5	36.4	43.0	28.3	37.5	32.1
≥ 7 days	20.4	29.7	25.3	52.2	40.6	47.4
Days income-earning was disrupted (mean)	5.0±3.1	5.3±3.1	5.1±3.0	7.0±4.2	9.2±5.6	7.6±4.6
Mean cost of treatment (Taka) (range)						
Visit	21.5 (500)	12.4 (200)	17.0 (500)	19.5 (300)	22.9 (300)	21.0 (300)
Drugs	178.1 (1000)	156.9 (1200)	167.5 (1200)	357.0 (5180)	177.0 (780)	279.4 (5180)
Transport	29.7 (500)	27.2 (400)	28.4 (500)	36.0 (700)	53.1 (1200)	43.4 (1200)
Total	229.3 (1500)	196.5 (1500)	212.9 (1500)	412.6 (5500)	253.2 (1800)	343.8 (5500)

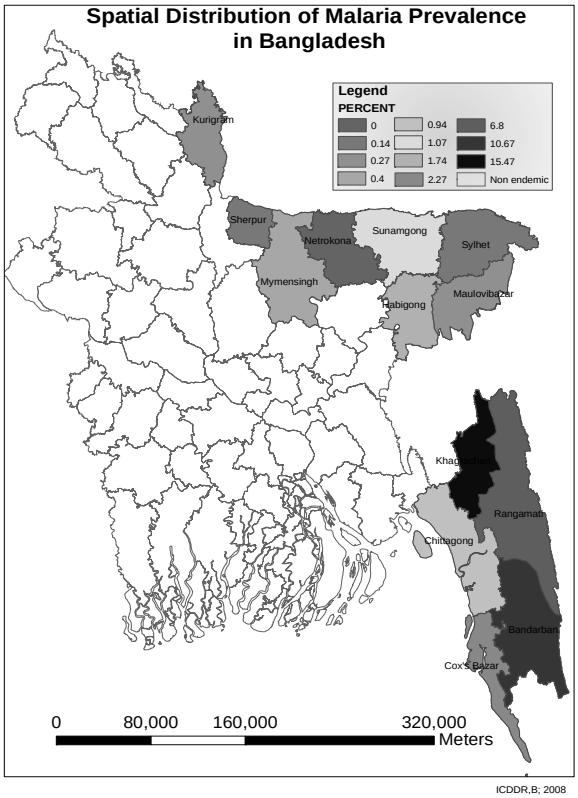
Prevalence and Distribution of Malaria

The malaria prevalence survey was conducted in 13 endemic districts and the total sample size of the individuals (>1 year of age) screened for malarial parasite was 9,750, taking one individual randomly from each household. For details of sampling strategy, see materials and methods.

MALARIA PREVALENCE IN 13 DISTRICTS

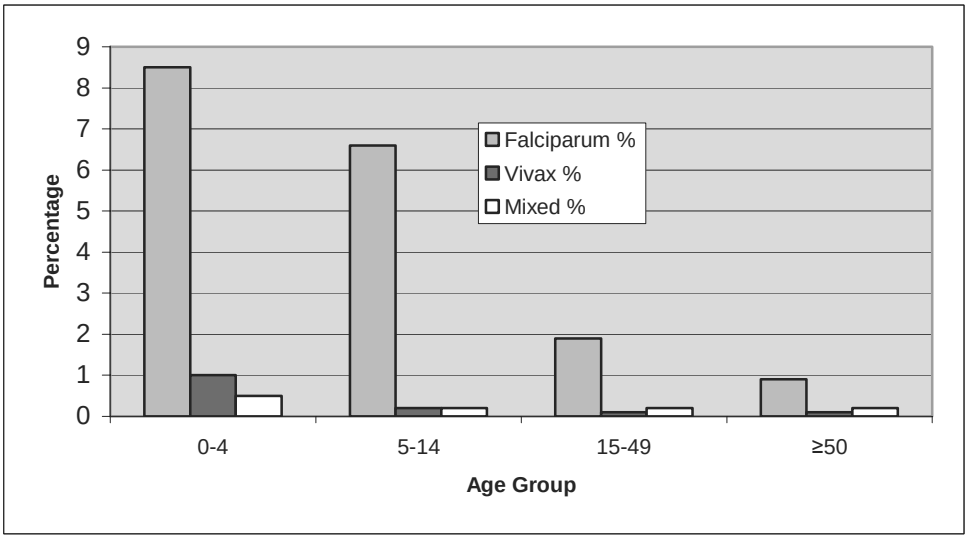
In 13 malaria endemic districts, the overall malaria prevalence rate was 3.1% (according to Rapid Diagnostic Test). The prevalence of *P. falciparum* was 2.73% and the *P. vivax* 0.16% and mixed infection with *P. falciparum* and *P. vivax* was 0.19%. The proportion of *P. falciparum* was 88.6% while *P. vivax* and mixed infection with these two species were 5.2 and 6.25% respectively in these 13 districts. Prevalence of malaria in these 13 districts is shown in Figure 3. There was no significant sex difference in the prevalence of malaria. Prevalence of *P. falciparum* in male was 2.9% while in female it was 2.6%.

Figure 3. Malaria prevalence in 13 districts of Bangladesh, 2007



The prevalence of malaria was significantly higher in children. The prevalence of *falciparum* malaria in children 0-4 years of age was 8.5% and 5-14 years of age 6.6% (Figure 4).

Figure 4. Prevalence of malaria according to age groups



In this survey, we have also calculated malaria morbidity in these 13 malaria endemic districts. Malaria morbidity was defined as presence of fever with a RDT positive result. The overall prevalence of malaria morbidity in these 13 districts was 12 per 1,000 while it was 29.4 and 0.7 per 1,000 in 5 SSE and 8 NNE districts respectively. Khagrachari, Bandarban and Rangamati districts had 15.5, 10.7 and 6.8 percent prevalence respectively.

MALARIA PREVALENCE IN NORTH/NORTH-EASTERN (NNE) DISTRICTS

The overall prevalence of malaria in eight NNE districts is 0.5%. Malaria morbidity in these eight north-eastern districts is 0.7 per thousand populations (Fig. 5). Prevalence of malaria in thanas of these 8 north-eastern districts is given in Annex Table 1 (See in annexure).

Habigong, Sylhet, Sunamgong and Maulovibazar are tea growing regions dotted with small hills. Malaria exists in Kurigram, Sherpur, Mymensingh, Sunamgong, Sylhet and Maulobibazar districts. However, in Netrokona no malaria was found in this survey (Figure 4). Two thanas in Netrokona (Durgapur and Kalmakanda) were included in sampling method. Both thanas share common border with Meghaloy, India and have high hills. Prevalence rate was 0.14% in both Sherpur and Sylhet, 0.27% in Kurigram and Maulovibazar, 0.4% in Mymensingh, 1.07% in Sunamgong, and 1.74% in Habiganj. Among the eight north-eastern districts, prevalence rate was highest in Habiganj district.

In Kurigram two thanas were surveyed. Only Raumari share common border with Asam, India. Vast land of Char Rajibpur is covered with water body. Raumari is comparatively high land areas close with high hills in (Asam) Indian border. No malaria case was found in Rajibpur but 0.35% in Raumari Thana was found to be malaria case positive. Other thanas were excluded during sampling as because those are known as non-endemic area (Figure 8 in annexure).

In Sherpur two thanas (Jhenaigati and Sreebardi) were included in malaria baseline survey. Both are in border areas with Asam, India. In Jhenaigati, no malaria positive case was found but, in Sreebardi the prevalence was 0.22% (See Figure 9 in annexure).

In Mymensingh, Haluaghat and Dhobaura were selected for malaria surveillance. Both thanas share the common border with (Asam) India. This area is also covered with water bodies. In Dhobaura no malaria positive case was found but, prevalence rate was 0.55 percent in Haluaghat (See Figure 10 in annexure).

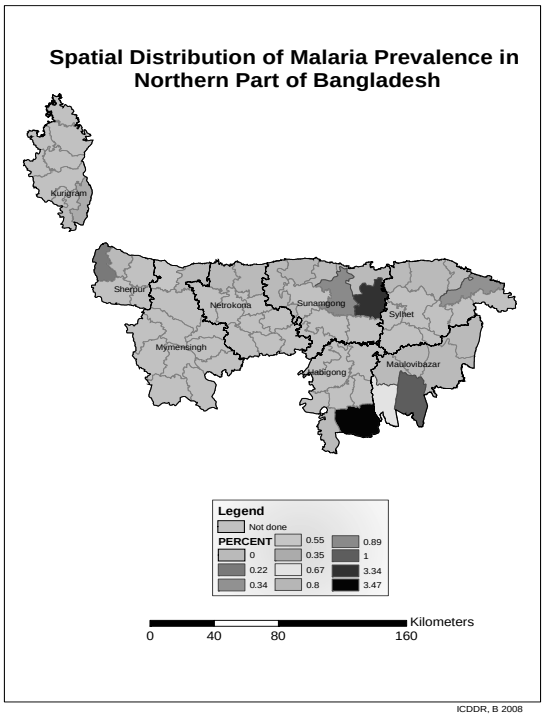
Gowanighat, Kanaighat, Jaintipur and Companigang were included in the sampling frame of this survey from Sylhet district. Other thanas were excluded as because those are not endemic. One positive case was found in Kanaighat. Overall prevalence rate was 0.14 percent (See Figure 11 in annexure).

In Sunamgong six thanas were included in sampling. All thanas share the common border with Meghaloy, India. A major part of Sunamgong is covered with water body. There are no malaria positives in Dharmapasha, Bishwarampur and Dowarabazar. But prevalence rate was 0.8, 0.89, 3.34 percent in Tahirpur, Sunamgong sador and Chattak respectively (See Figure 12 in annexure).

Maulovibazar is also a border district with Tripura, India. All thanas of Maulovibazar were known as endemic and included in sampling. Prevalence rate was 0.67 and 1 percent in Sreemangal and Kamalgong respectively. In other thanas of Moulovibazar district we did not get any malaria positive case (See Figure 13 in annexure).

Habigang is also a bordering district with Tripura, India. Chunarughat and Madhabpur were selected in this survey. We did not get any malaria positive from Madhabpur but, 3.34% prevalence in Chunarughat (See Figure 14 in annexure).

Figure 5. Malaria prevalence in North/North-eastern districts of Bangladesh 2007



MALARIA PREVALENCE IN SOUTH/SOUTH-EASTERN (SSE) DISTRICTS

Malaria is much more endemic in SSE districts of Bangladesh compared to eight NNE districts (Fig. 6). Prevalence rate is also very high along the border areas with Mayanmar. We did not carry out survey in Juarichari and Naniarchar Thanas in Rangamati district and Lakschichari thana in Khagrachari district because of security reasons. Our survey team couldn't work in these areas of two distrcits. The overall prevalence of malaria in these 5 south-eastern districts was 7.2%. Malaria morbidity in these 5 south-eastern districts is 29.4 per thousand populations. Prevalence of malaria in thanas of these 5 south-eastern districts is given in Annex Table 2 (See in annexure).

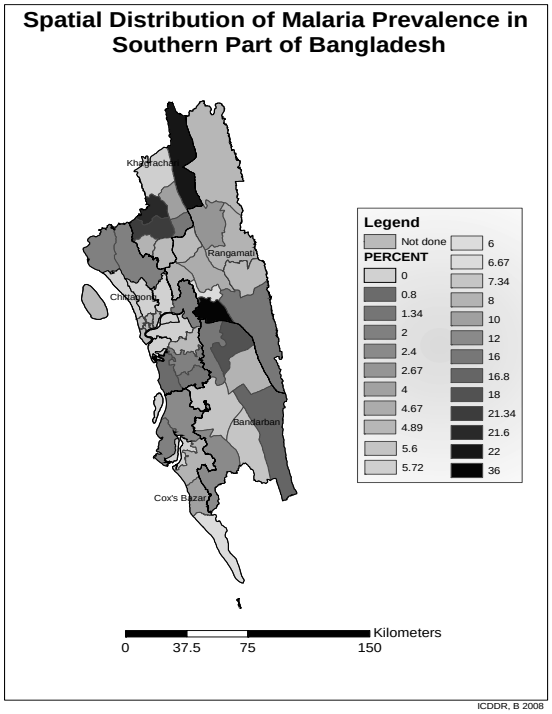
In Cox's Bazar our sampling method covered all endemic thanas except Kutubdia. Among them Ramu, Teknaf, Ukhia, Chakaria ad Maheshkhali have 8, 6, 4, 2.4 percent prevalence respectively. In Cox's Bazar sador thana we did not get any malaria prevalence (See Figure 15 in annexure).

In south-eastern districts, the malaria prevalence rate is highest in Khagrachari district after that Bandarban, Rangamati and Cox's Bazar districts have the highest prevalence and their prevalence rate was 10.7, 6.8 and 2.3 percent respectively.

In Khagrachari, it was not possible to work in Lakshcichari but rests of the thanas were under this prevalence survey. Lowest prevalence rate in Khagrachari district was 5.72% in Panchari Thana and the highest prevalence is 22% in Dighinala Thana. Both are border areas with Tripura, India and Mayanmar respectively. Prevalence rate was 8, 10, 16, 21.3 and 21.6 percent in Manikchari, Khagrachari sador, Mahalchari, Ramgarh and Matiranga respectively (See figure 16 in annexure).

Rangamati is the biggest district in Bangladesh. This district is covered with hilly forest and Kaptai Lake. Settlement is sparsely distributed in all over the district. There are significant malaria prevalence rate in Rangamati too. Malaria situation of Rangamati is comparatively better than Khagrachari. There is sufficient malaria prevalence in each and every thanas. In Rajasthali the prevalence was 36 percent which is highest prevalence in one endemic thana that we have surveyed. Prevalence rate was 2.67, 4.67, 4.89, 6.67, 8 and 16 percent in Langudu, Rangamati sador, Baghai Chari, Kaptai, Barkal, Kawkhali and Belai Chari respectively (See Figure 17 in annexure).

Figure 6. Malaria prevalence in 5 South/South-eastern districts of Bangladesh



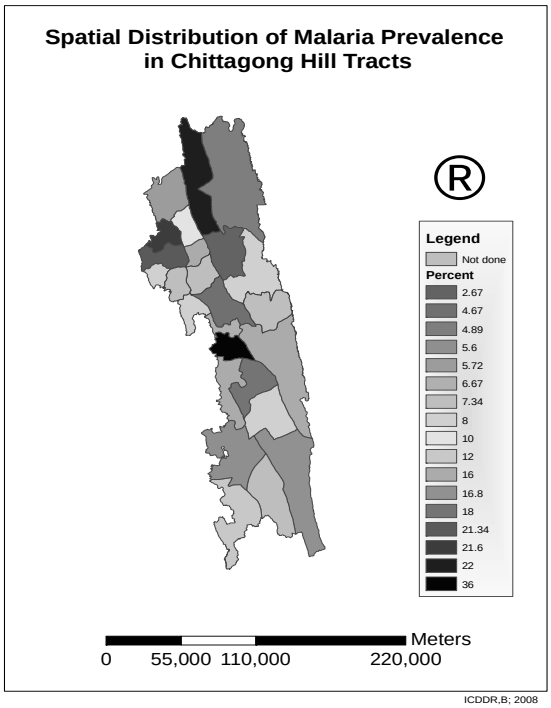
Malaria is also highly prevalent in Bandarban district. Our sampling method covered all thanas of Bandarban districts and there are also high prevalence rate in all Thanas. Lama share common border with Cox's Bazar and have 5.6 percent prevalence and that is the lowest in Bandarban. Rowanchari located in deeper part of Chittagong Hill Tracts and share common border with Mayanmar have 18 percent prevalence which is highest in Bandarban. Prevalence rate was 7.3, 8, 12, 16, and 16.8 percent in Alikadam, Ruma, Naikhangchari, Bandarban Sador and Thanchi respectively. Malaria exists in all Thanas of Bandarban district (see Figure 18 in annexure).

Malaria prevalence rate is 0.94% in Chittagong. There are also some thanas in Chittagong where we did not get any malaria like Sitakunda, Raozan, Hathazari, Patiya, Boalkhali, Anowara, and Banshkhali. Moreover malaria is not endemic in Sandwip, Chandgaon, Panchlaish, Pahartali, Double Mooring, Kotwali, Chittagong port and excluded from our sampling method. In Chittagong district prevalence rate was 2% in Fatikchari, Mirsharai, Rangunia and Satkania. Prevalence rate was 1.34% and 0.8% in Lohagora and Banshkhali respectively (See Figure 19 in annexure). Moreover Fatikchari, Raozan, Rangunia and Satkania share the border with the Chittagong Hill Tracts districts that might be a significant cause of high prevalence.

MALARIA PREVALENCE IN CHITTAGONG HILL TRACTS

The overall malaria prevalence in Chittagong Hill Tracts is 11% (Fig 7). Prevalence rate was 15.5, 10.7 and 6.8 percent in Khagrachari, Bandarban and Rangamati districts respectively. The overall malaria morbidity in these three Hill districts was 45 per thousand populations.

Figure 7. Malaria prevalence in Chittagong Hill Tracts



COMPARISION OF MICROSCOPY AND RDT FOR DIAGNOSIS OF MALARIA

All positive (according to RDTs) and randomly selected 2 % negative slides at the field site were examined by microscopy by technicians at the field site and the slides were brought back to Parasitology Laboratory of ICDDR,B for re-checking. Table 1 below shows the results obtained by RDT and two microscopy on 597 samples. RDT is 84 % sensitive for detection of *falciparum* malaria when compared to field microscopy and lab microscopy. However, RDT detected more cases of malaria than the microscopy (Table 13) and these are true malaria cases as detected by PCR.

Table 13. Comparison of the RDT (FalciVax) assay, microscopy by the technicians in the endemic districts (Field Microscopy) and, microscopy at the ICCDR,B (2nd Microscopy) in 597 people.

	Field Microscopy	2nd Microscopy	RDT (FalciVax)
P. falciparum	122	163	195
P. vivax	11	2	11
Mixed (*P.f* + *P.v*)	0	16	18
Total	133/597 (22.3%)	181/597 (30.3%)	224/597 (37.5%)

Discussion

The role of social science research in the design and implementation of evidence-based prevention, management and control strategies for malaria cannot be overemphasized (Mwensi 2005). Bangladesh lacks this kind of data for design of targeted interventions for prevention and control of malaria in the 13 endemic districts referred to above. This baseline survey attempts to fill in the knowledge gaps in this regard by presenting data on malaria knowledge and practices (including parasitological prevalence survey) from a population based survey in the 13 endemic districts. Findings revealed superficial knowledge on malaria and its prevention and treatment, especially among the poor and the illiterate and found these two factors as important determinants of malaria-related knowledge and practices, as also observed elsewhere (Sharma *et al*. 2007). Overall malaria prevalence was found to be 3.1%, with 2.73% *P. falciparum* and 0.16% *P vivax*. These findings with its implications for the programme are described below.

MALARIAL KNOWLEDGE, PREVENTION AND HEALTH-SEEKING BEHAVIOUR

The general health awareness of the respondents was quite high. They were also highly familiar with the term 'malaria' , also seen in some countries like Malawi (Coombes *et al.* 1998) and Delhi, India (Tyagi *et al.* 2005), but unlike women in Iran (Rakhshani *et al.* 2003). The observation in this study that malaria is caused and transmitted by bite of mosquito is a common knowledge in malaria endemic countries such as Turkey, India, Nepal, Haiti, Latin America, Sudan and Ghana (Simsek and Kurcer 2005, Tyagi *et al.* 2005, Joshi and Banjara 2008, Keating et al. 2008, Kroeger *et al.* 1996, Adam et al. 2008, De La Cruz *et al.* 2006). However, only a tiny fraction could accurately state the correct transmission route ('by bite of mosquito which has bitten a malarial patient') and none could state how the mosquito becomes infective i.e., the parasitological cause. The serious gaps in knowledge is also revealed by one-third of the respondents stating that they did not knew the mode of transmission and another one-third stating

that any mosquito bite causes malaria. Malaria control programmes need to address these gaps while designing health education interventions, and especially target the poor and the semi-literate, as these groups had lower level of knowledge compared to their counterparts. Health education interventions should be designed according to the existing knowledge and awareness level of vulnerable population as well as their current treatment-seeking practices, and should be implemented for sufficient length of time to be effective (Kroeger *et al.* 1996)

The association of febrile illness with malaria is known in Bangladesh for a long time (Faiz 1982). This is also reiterated in this study where the majority of the respondents mentioned fever (with shivering, at intervals) as the most common symptom of malaria and is consistent with observations from other countries (Adam et al. 2008, Joshi and Banjara 2008, Das et al. 2007, Simsek and Kurcer 2005, Jimar *et al.* 2005, Rakhshani *et al.* 2003, Kroeger 1996).

Knowledge on use of bed net as a preventive measure against mosquito bite was high among the respondents in this study. Similar high level of knowledge on preventive use of bed net is observed from Nepal (Joshi and Banjara 2008) and Ghana (De La Cruz et al 2006), but at a lower level in other countries such as Ethiopia (Jima *et al.* 2005), Iran (Rakhshani *et al.* 2003), Delhi, India (Tyagi *et al.* 2005), Turkey (Simsek and Kurcer 2005), and Haiti (Keating *et al.* 2008). This will make programme's work easy in introducing bed net and its treatment with insecticides (or distributing ITNs) as strategic measure for preventing malaria transmission. However, programme needs to keep the equity perspective in focus while distributing ITN bed nets or treatment of bed nets with insecticides because the poorer households were disadvantaged in bed net possession or insecticide treatment of bed nets.

The respondents were unanimous about the use of modern medicine (allopathic) for treatment of malaria and that they would seek treatment from allopathic providers, whether in the formal or informal sector. However, the 'know-do' gap became especially evident when in practice majority of the ill persons either did not seek any treatment (43%) or practiced self-treatment (18%). The latter corroborates with findings from Turkey (Simsek and Kurcer 2005) where majority practice self-treatment for malaria. Of those who sought treatment, majority went to the informal allopathic providers such as village doctors and drugstore salespeople whose knowledge and capacity for curative treatment is not without question (Ahmed and Hossain 2007). Also, there was a delay in the beginning of treatment in more than half of the instances of febrile episodes suggestive of malaria. Thus, efforts will be needed to educate this population on the need for 'Early Detection and Prompt Treatment (EDPT)', and also develop the capacity of the informal allopathic providers (important for treatment of poor) in the use of Rapid Diagnostic Tests (RDTs) and rational use of Artemisinin-based combination drugs (CoArtem).

Throughout this study gender divide in knowledge, awareness and health-seeking behaviour was observed disfavouring women. This is not surprising, given the patriarchal norms in the society and was also noted earlier in other studies (Ahmed 2005). While designing interventions, pro-active measures should be undertaken by Malarial prevention and control programme to reduce this gender gap. This is all the more necessary because experiences show that even women focused interventions may not increase access of quality health care for women if the gender issues are not explicitly addressed by the programme (Ahmed *et al.* 2006).

Lastly, a few words about regional differences. The SSE area was found to have greater proportion of poorest households (in terms of asset quintiles) than the NNE area. The SSE area respondents also appeared to be disadvantaged regarding different aspects of malaria prevention and treatment than the NNE area, though marginal. However, this difference has to be taken into consideration while delivering interventions such as health education and bed nets etc.

MALARIA PREVALENCE

Accurate information on incidence and prevalence is necessary for planning control activities and monitoring their efficacy over time. It is also an indicator of effectiveness of the methods used for evaluating the impact of malaria on public health and economy (Carter and Mendis 2006; Snow *et al.* 2005). In this study, the first large population-based survey was conducted to provide baseline parasitologic information for population living in malaria endemic area of Bangladesh. This cross-sectional survey provides a point prevalence of malaria in these 13 districts of Bangladesh. Additional studies need to be done at different time point.

Malaria is not equally distributed in all malaria endemic districts of Bangladesh. Prevalence of malaria in 5 south-eastern districts is significantly higher than the 8 north-eastern districts. Chittagong Hill Tracts districts have the highest prevalence than the other endemic districts. The survey was carried out in peak seasons in five south-eastern districts but it was not possible to carry out the survey at the same time in the eight north-eastern districts. Among the five south-eastern districts, Chittagong is comparatively lower endemic. Results from this prevalence survey clearly indicates that the south-eastern districts are the high endemic districts where both the prevalence and morbidity are higher than the north-eastern districts. In this survey we have used a RDT that is capable of detecting both *P. falciparum* and *P. vivax*. So, we were also able to detect the prevalence of mixed infection with these two species of malaria.

For the first time the rate of fever–associated malaria infections was documented at the community level. Unsurprisingly, a much higher prevalence than reported by national passive surveillance was observed. However, not all fever cases were attributable to malaria, confirming that fever is a poor indicator for presumptive treatment of malaria, even in an area of low transmission. This has also been observed by other investigators (Luxemburger C *et al.* 1998). A large overlooked reservoir of asymptomatic malaria infection was identified in 5 south-eastern districts of Bangladesh. Existence of such reservoir of malaria parasites should be considered in the future follow-up of control measures. Longitudinal studies are needed to assess the variation of asymptomatic parasite carriage over time, and its exact contribution to transmission. Population-based prevalence studies on a regular basis are required to understand the burden of disease.

Our study results confirm the existence of malaria in Raumari, Sreebardi, Haluaghat, Chunarughat and Kanaighat *Thanas* in Kurigram, Sherpur, Mymensingh, Habigong and Sylhet districts respectively. Malaria is also prevalent in Sreemangal and Kamalgong *Thanas* in Maulovibazar district. Malaria also exists in Tahirpur, Sunamgong sador and Chattak *Thanas* in Sunamgong district. Malaria is not prevalent in other *thanas* in eight north-eastern districts. Maheshkhali, Chakaria, Ukhia *Thanas* in Cox's Bazar district and Fatikchari, Mirasarai, Rangunia and Satkania *Thanas* in Chittagong district have elevated prevalence rate. All *Thanas* of Chittagong Hill Tracts districts contain sky-scraping prevalence of malaria.

Summary and Implications

SOCIOECONOMIC SURVEY

The key findings from the socioeconomic survey can be summarized as follows:

- The general health awareness of the respondents was high; those from south/south-east (SSE) area trailed behind those from the north/north-east (NNE) area, albeit marginally.
- However, the knowledge on causation, transmission, prevention and control of malaria was not comprehensive.
- Education, SES and gender were important determinants in shaping these different aspects of malaria; marginal differences were observed with respect to the two areas.
- The possession of at least one bed nets by the households was almost universal, the total number varying according to asset quintiles; however, insecticide treatment of bed nets was poor.
- Major proportion of patients with malaria-like febrile illness either did not seek any treatment or practiced self-treatment only.
- Of those who sought treatment, majority went to the informal allopathic providers; gender and SES gradient disfavouring women and poorest was observed.
- For majority of the patients, treatment was delayed beyond 24 hours.
- The cost for malaria-like illness is quite high, especially in the NNE area.

Implications for programme

- IEC component of the programme should aim at disseminating comprehensive information on malaria transmission, prevention and control; combination of audio-visual and print media will be required to reach the targeted audience such as the poorest households and the women.
- The IEC campaign should emphasize the necessity of EDPT so that community is convinced about the need for initiating treatment without delay for malaria-like illness and reduce instances of 'no treatment' and 'self-treatment'.
- Trained health workforce to deliver EDPT should be assured simultaneous with convering the 'unfelt need' to 'felt need' for diagnosis and treatment.
- Insecticide treatment of bed net should be given utmost priority until ITN can be assured to every household in required number; health education campaign to explain utility of bed net/ITNs in preventing malaria should be strengthened.
- Equity focus in terms of gender and SES should be maintained in every stage of programme implementation.

MALARIA PREVALENCE SURVEY

The key findings from the malaria prevalence survey can be summarized as follows:

- For the first time the point prevalence of malaria from 13 malaria endemic districts of Bangladesh is obtained from this study.
- The burden of malaria in five SSE districts is more than the 8 NNE districts; Malaria is more prevalent in children than the adults.
- Chittagong Hill Tracts (CHT) districts are the most endemic districts in Bangladesh.
- A large overlooked reservoir of asymptomatic malaria infection was identified in the malaria endemic districts.
- Both *P. falciparum* and *P. vivax* are prevalent in the malaria endemic districts but, *P. falciparum* is the predominant species.
- Not all fever cases are attributable to malaria; RDT detected more malaria cases than the microscopy.

Implications for programme

- Current strategies for the national malaria control programme should be more focused in five SSE districts especially in the Chittagong Hill Tracts districts. Especial emphasis should be given for diagnosis and treatment of malaria in children since they are the most common sufferers.
- Asymptomatic falciparum malaria infection is common in these five SSE districts and the national malaria control programme should take appropriate measures for their treatment.
- Some areas within a District or *Thana* are more endemic than the other areas of that *Thana*. So, programmes should take this into consideration while allocating resource (diagnostics and drugs).

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Annexures

Annex Table 1. Malaria prevalence in North/North-eastern *thanas* of Bangladesh

District	*Thana*	Percentage of Malaria positive
Sunamgong	Chattak	3.3
	Sunamgong Sador	0.89
	Tahirpur	0.8
Maulovi Bazar	Sreemangal	0.67
	Kamalgong	1
Kurigram	Raumari	0.35
Sylhet	Kanaighat	0.34
Habigong	Chunarughat	3.2
Mymensingh	Haluaghat	0.55
Sherpur	Sreebardi	0.22

Annex Table 2. Malaria prevalence in South/South-eastern *thanas* of Bangladesh

District	*Thana*	Percentage of malaria positive
Bandarban	Alikadam	7.3
	Bandarban Sador	16
	Lama	5.6
	Naikhangchari	12
	Rowanchari	18
	Ruma	8
	Thanchi	16.8
Rangamati	Rangamati Sador	4.7
	Rajasthali	36
	Baghaichari	4.89
	Barkal	8
	Kawkhali	8
	Belai Chari	16
	Kaptai	6.7
	Langudu	2.6
Khagrachari	Dighinala	22
	Khagrachari Sador	10
	Mahalchari	16
	Manikchari	8
	Matiranga	21.6
	Panchari	5.7
	Ramgarh	21.34
Cox’s Bazar	Ukhia	4
	Chakaria	2.4
	Ramu	8
	Teknaf	6
Chittagong	Satkania	2
	Fatikchari	2
	Mirasari	2
	Rangunia	2
	Banskhali	0.8
	Maheshkhali	2
	Lohagara	1.3

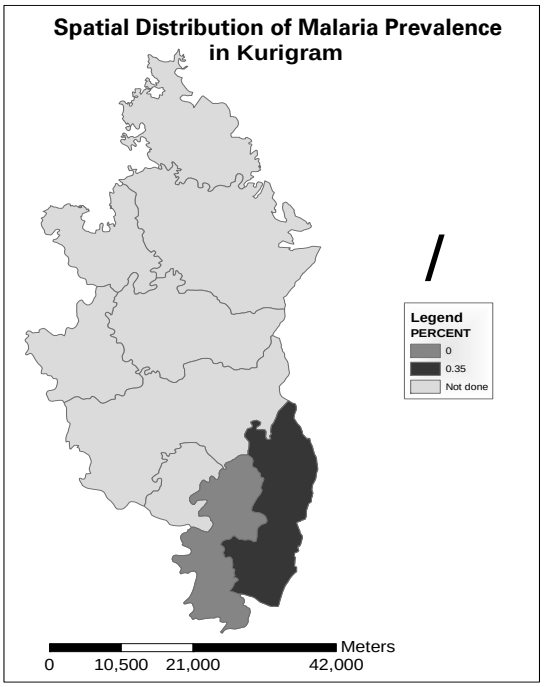
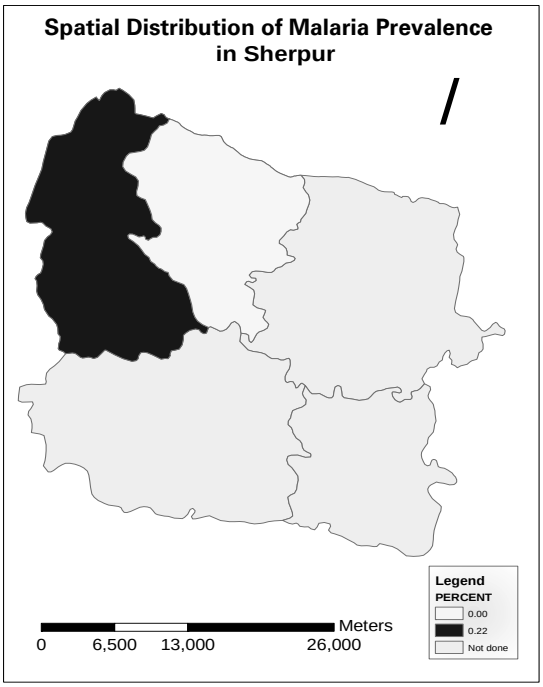


Figure 8



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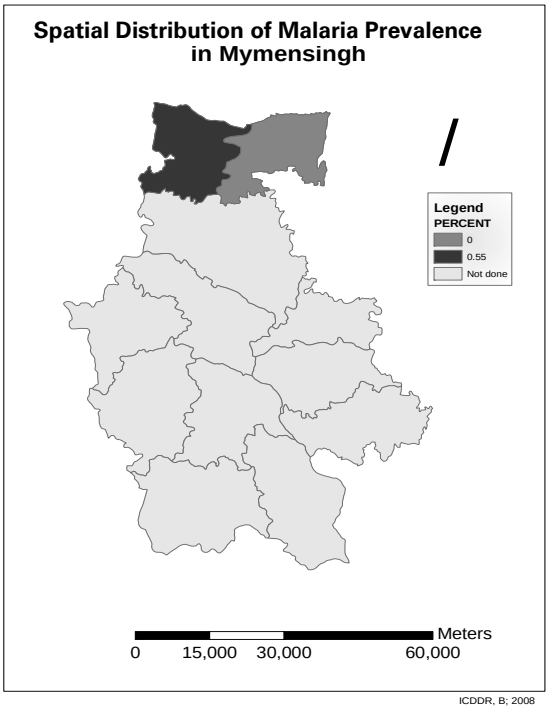

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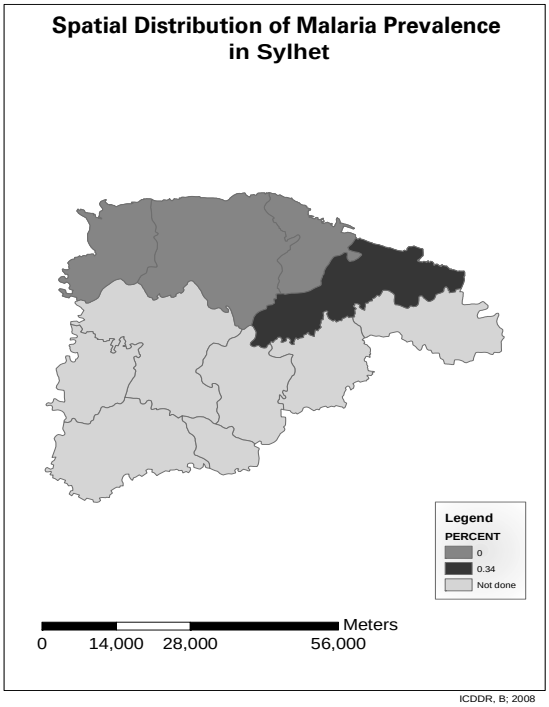

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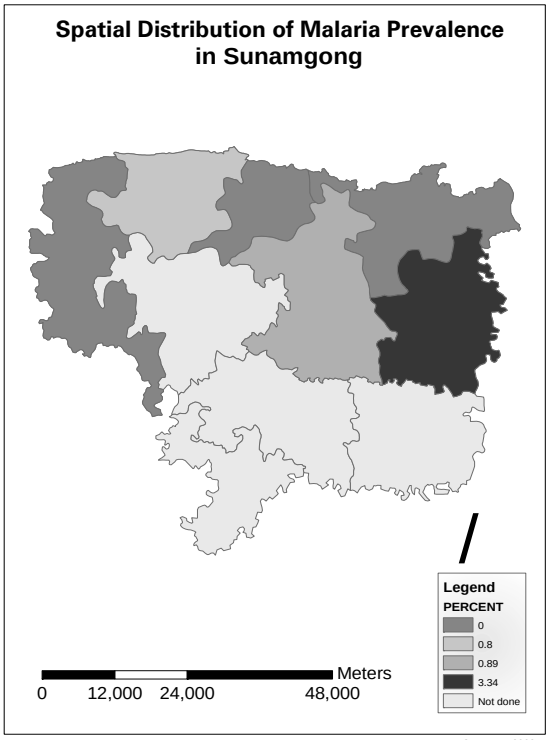

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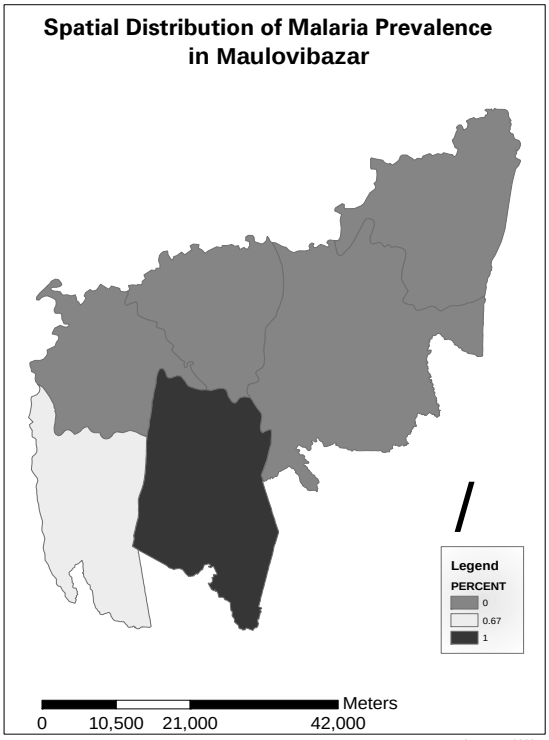
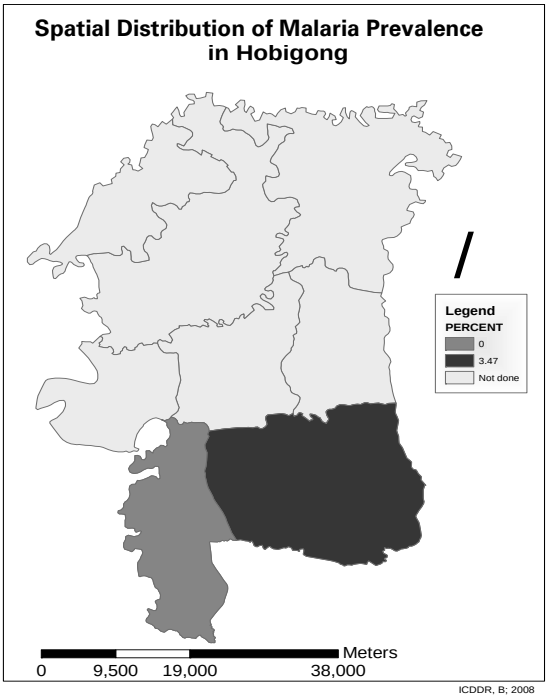


Figure 13



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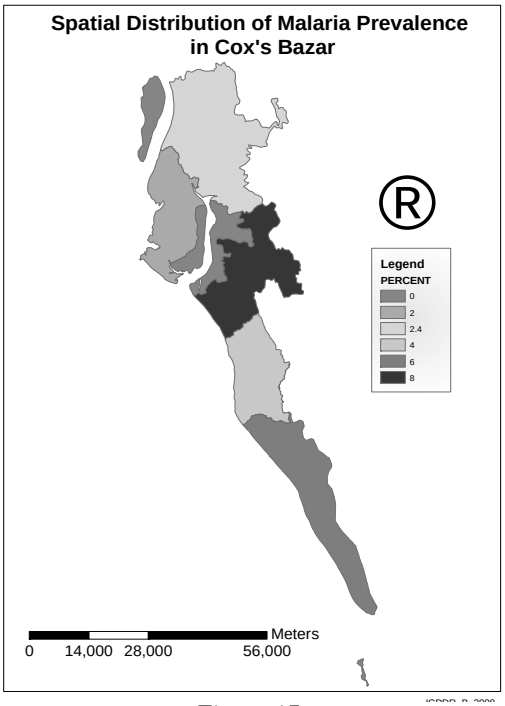
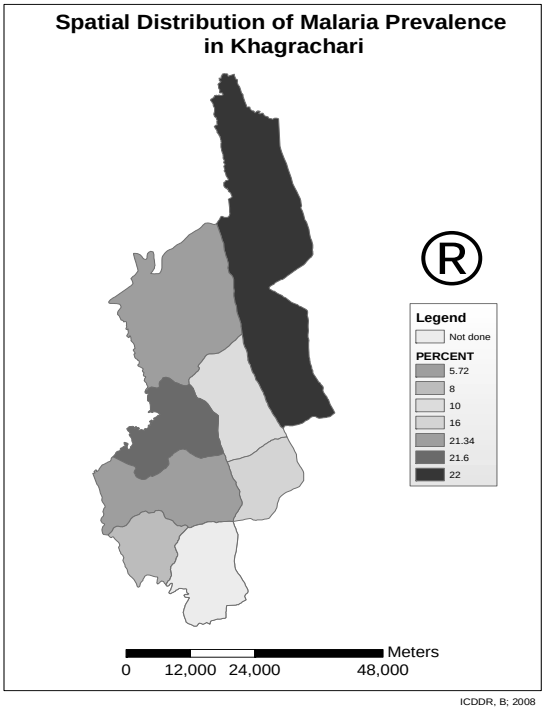


Figure 15



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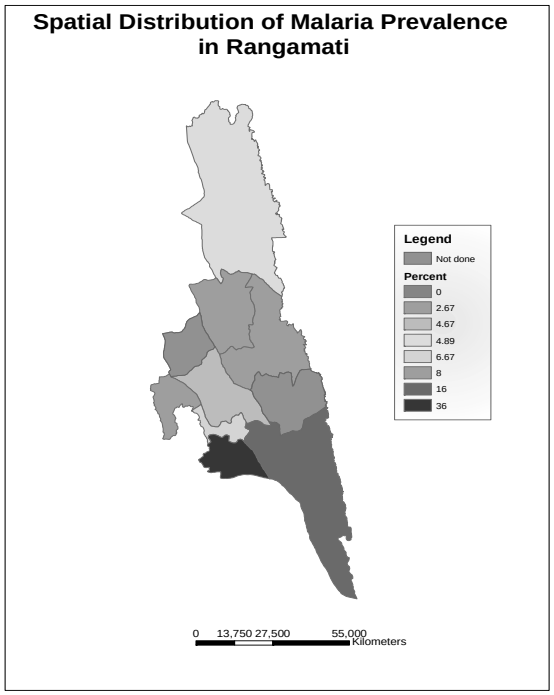

Figure 17

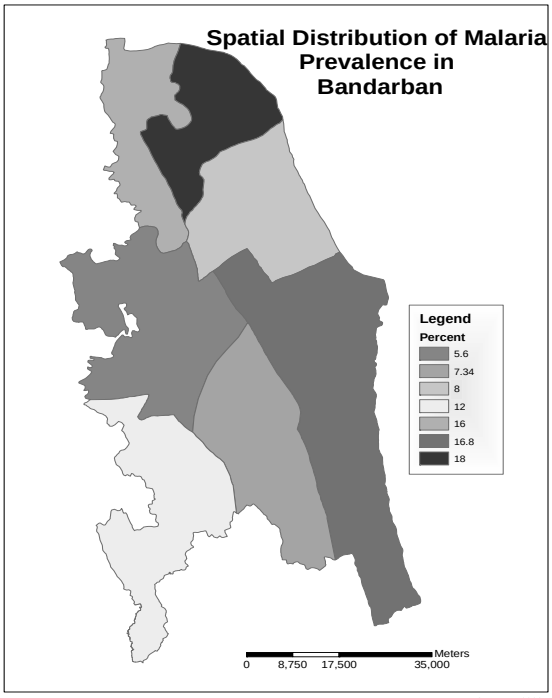

Figure 18

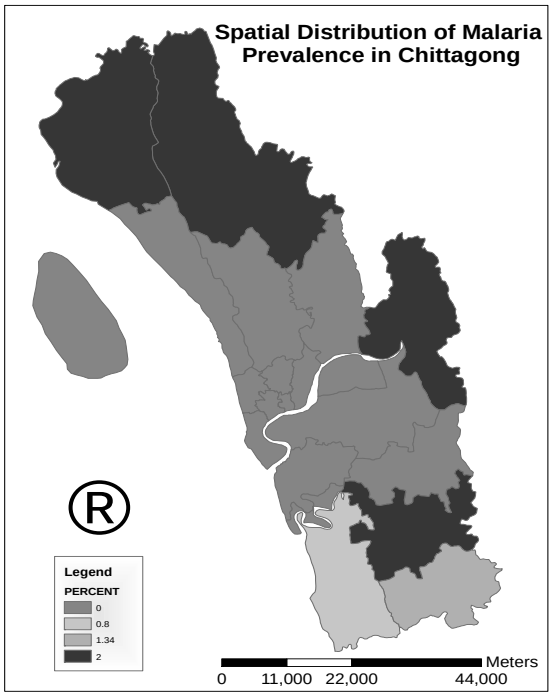

Figure 19