# Thailand Malaria Survey 2012

Baseline survey

Final report
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## ABBREVIATIONS

| | |
|---|---|
| BCC | Behaviour Change Communication |
| BDVU | Vector-Borne Disease unit |
| BMP | Border malaria post |
| G6PD | Glucose 6-phosphate dehydrogenase |
| GFATM | Global Fund to Fight AIDS, Tuberculosis and Malaria |
| GPARC | Global Plan for Artemisinin Resistance Containment |
| HF | Health facility |
| IRS | Insecticide Residual Spraying |
| ITF | International Task Force |
| ITN | Insecticide treated net |
| KAP | Knowledge, Attitudes and Practices |
| LLIN | Long Lasting Insecticidal Net |
| LSHTM | London School of Hygiene and Tropical Medicine |
| M&E | Monitoring and Evaluation |
| MIS | Malaria Indicators Surveys |
| MP | Malaria post |
| PCA | Principal component analysis |
| PCR | Polymerase Chain Reaction |
| Pf | Plasmodium falciparum |
| Pv | Plasmodium vivax |
| RDT | Rapid Diagnostic Test |
| TMS | Thai Malaria Survey |
| VBDC | Vector-Borne Disease Control |
| VHV | Village Health Volunteer |
| VMW | Village Malaria Worker |
| WHO | World Health Organisation |

## EXECUTIVE SUMMARY

The Thai Malaria Survey (baseline) was conducted between mid-November 2012 and February 2013, by a partnership of the Thai Bureau of Vector Borne Disease (BVBD) and Malaria Consortium. This large scale household and prevalence survey was funded by the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), Round 10 and addressed indicators of the interventions to contain artemisinin resistance and the intensified malaria control activities. The main purpose of the survey was to measure malaria knowledge, attitudes, and practices of people in 43 provinces and to provide an estimate of malaria prevalence using microscopy, Polymerase Chain Reaction (PCR) and serological measures as a baseline to monitor malaria transmission in an elimination setting. The household malariometric survey focused on the population living in areas with ongoing malaria transmission (A1-perennial transmission and A2-periodic transmission). A total of 3300 households in 83 clusters were visited and interviewed, of which all individuals found on the survey day were tested for malaria; a total of 10,834 blood samples were collected and analyzed using standard microscopy, molecular analysis (PCR) as well as serological measurements.

Malaria prevalence based on microscopy the survey day was lower than the 0.5 to 1.5% anticipated. Only two out of the 10,834 individuals in the sampled households were identified as malaria positive by microscopy. Both cases were adults over than 14 years old and lived in Domain 3. One case was P. falciparum and the other was P. vivax. Malaria prevalence based on PCR was 0.1% (7 cases). People positive for malaria through PCR were found in all three domains and were all adults over than 14 years old. Four were identified as P. falciparum and 3 were P. vivax. Interestingly, none of the cases reported any fever episode in the previous two weeks. Six out of the infected people were from a poor socio economic background (quintiles 1 or 2) and seven of them were Thai, compared to only one migrant (M2). Half of the malaria cases reported having an activity involving some exposure to malaria risk such as working in the forest (2/8=25%) or travelling away from home (2/8=25%). None of these people used an insecticide treated net (ITN) the night before the survey, only 1 of them was living in a household with sufficient ITN to ensure universal access and only one was living in a household where the respondent remembered any of the behaviour change communication (BCC) messages. Serological results are not yet reported, as analysis is ongoing. The prevalence of reported fever episodes in the whole surveyed population in the previous two weeks was 4.2% and that proportion was higher at the Thai Myanmar border with 5.3%. As one would expect, children under five years of age were more likely to have been affected by a recent fever episode (12.1%, $p<0.001$) compared to older age categories.

The level of knowledge and awareness of malaria of the population living in the survey area (A1 and A2 villages) was quite poor; 47.3% of respondents knew malaria is transmitted by *Anopheles* bite but 18.2% mentioned a wrong transmission mode and 16.2% did not know. Some 44.4% of respondents mentioned at least one other prevention method in addition to using a net while only 10.6% said using an insecticide treated net (ITN) and 16.8% did not know any advantage of using ITNs. The level of knowledge of people living at the Thai Cambodia border appeared higher than the rest of the country, which is encouraging considering the recent efforts to reduce malaria transmission in these villages. For example, 80% of respondents in that area knew that ITNs repel mosquitoes.

Household ownership of ITNs was insufficient to ensure universal access for all household members; 92.2% of households owned at least one mosquito net of any type at the time of the survey but only 46.5% owned any ITN. Household ownership of sufficient nets defined as one net for every 2 people was 79.1% for nets of any type, 28.6% for ITNs and 20.9% for LLINs. In general, net ownership was higher at the Thai Cambodia border and lower in Domain 3[3]. Poorer households were more likely to own a net and this trend was most marked for LLINs. Nearly two thirds (64.0%) of nets were untreated and only a quarter (26.1%) of all nets were LLIN. Out of all nets, 58.9% were acquired less than 2 years ago; 54.5% were bought in a shop or the local market and 24.4% were distributed by the government or the village health volunteer. The most important determinant for a household to buy a new net was insufficient quantity of nets owned (1 net for every 2 people). Even if these households would be more likely to buy a new net, 38.7% would not know where to go and 20% considered that they had enough nets even if the ratio of nets per people was less than 1:2. Household coverage of other methods for prevention included Indoor Residual Spraying (IRS) with 38.8% houses sprayed in past 12 months, mosquito repellent usage (35.4% of households) and to a lesser extent mosquito wire screen usage on windows (5% of households). The proportion of households protected by either IRS or owing sufficient ITN was 54.6% and this proportion was higher at the Thai Cambodia border with 73.4%.

Looking at actual net use the night before the survey, 79.9% of all people living in sampled households slept under a net and 28.7% used an ITN[4]. Several factors were found to be determinants for net use. People living at the Thai Cambodia border were more likely to use a net of any type as well as ITN. The poorest people were also more likely to use an ITN and a LLIN compared to other wealth quintiles. It was worrying that net use in households with at least 1 ITN for every 2 people was 39.9%, still far below the 80% target established under Thailand's GFATM Round 10 programme, even if people had theoretically enough nets for universal access. However, the high use rate of any net including untreated nets indicates an encouraging continued demand for nets. The most common reasons for not using nets were subjective with 44.8% answering feeling hot or discomfort and this was true for all domains.

Out of all sampled households, 37.5% of household respondents had heard any information on malaria in the previous 6 months and the coverage was even lower in the 2 domains at the borders with Myanmar and Cambodia. Messages most remembered were "Sleep under an ITN" with 40.0%, "Get tested if malaria suspected" with 39.6% and "Complete treatment" with 14.9%. At the Thai Cambodia border, the message relating to malaria testing was far less mentioned with only 21.2%. Most common sources of information were "Village Health Volunteer (VHV) /malaria post or clinic" with 68.9% and "Malaria clinic/Vector-borne Disease Unit (VBDU) staff" with 34.5%. At the Thai Cambodia border, sources of message were more diverse and included channels specific to BCC activities such as leaflets and posters but interpersonal communication with family, friends, relatives or neighbours was higher in villages with fewer BCC channels such as in Domain 3. It was very encouraging to find that BCC messaging had an impact on the behaviour of people working in the forest in terms of net use the last time they visited the forest.

[3] Domain 1= Thai Myanmar border; Domain 2 = Thai Cambodia border; Domain 3 = remaining provinces
[4] ITN include LLIN based on commercial brand and net treated with an insecticide within the past 12 months.

Treatment seeking of reported fever cases in the previous 2 weeks was quite high with 77.4% having gone to a health provider of any kind and 73.4% of them doing so within 48 hours. The 2 major sources of health care were public health facilities (66.0%) and private health facilities (19.8%). It was encouraging to see that a drug store was not a popular source for health care with only 10 cases (2.8%) seeking treatment from there. In the same way, knowledge of sources for malaria testing and treatment was really encouraging with the vast majority of respondents mentioning malaria posts or public health facilities. However, 73.8% of the 22.6% people (=76 individuals) not seeking treatment actually preferred using traditional medicine and this proportion reached more than 95% at the Thai Cambodia border.

Awareness of malaria risk was quite low considering the threat of artemisinin resistance; 44.8% of household respondents felt at risk for malaria. It was interesting that at the Thai Cambodia border, respondents were less likely to have ever heard of malaria (79.9%) but if they did, they were more prone to mention malaria as one of the top three causes of fever (43.0%). This strongly suggests that recent BCC efforts in these villages had some impact in raising general awareness. On the other hand, only a third of respondents (33.2%) felt at risk of malaria at the Thai Myanmar border, which is worrying considering population movements across the border and the higher malaria transmission levels in some part of Eastern Myanmar.

Among reported fever cases that sought treatment, only 15.9% had a test for malaria. This was not surprising as the level of knowledge about malaria diagnostic services was poor. Out of all sampled respondents, only 16.2% said they would confirm malaria diagnosis through a blood test, as currently recommended. Knowledge of malaria signs and symptoms among people that had ever heard of malaria was quite high in Domain 3 but lower in the border areas. For example, fewer than 60% of respondents in these villages mentioned fever as a malaria sign; overall, 9.2% did not know any sign or symptoms. These low percentages may reflect the declining experience of malaria in the communities.

In conclusion malaria prevalence in areas of concern for artemisinin resistance is very low as measured both by microscopy and standard PCR, which is very encouraging. While the survey was undertaken during the malaria transmission season, some of it was towards the end and after the usual peak. Whilst use of any net is high the use of treated nets is not at the target levels. The challenges of maintaining awareness of malaria at very low transmission levels are noted, but knowledge of sources of malaria testing and treatment remains high.

**SUMMARY INDICATORS**

| | TOTAL | | Domain 1 (Thai-Myanmar border) | | Domain 2 (Thai-Cambodia border) | | Domain 3 (Remaining provinces) | |
|---|---|---|---|---|---|---|---|---|
| | % (n) | 95%CI | % (n) | 95%CI | % (n) | 95%CI | % (n) | 95%CI |
| **Malaria prevalence** | | | | | | | | |
| Microscopy | 0.0 (2) | 0.0 to 0.1 | -(0) | - | -(0) | - | 0.1 (2) | 0.0 to 0.2 |
| PCR | 0.1 (7) | 0.0 to 0.1 | 0.1 (2) | 0.0 to 0.2 | 0.1 (3) | 0.0 to 0.3 | 0.1 (2) | 0.0 to 0.2 |
| **Prevalence of reported fever in previous 2 weeks (N=10,833)** | | | | | | | | |
| | 4.2 (456) | 3.5 to 5.0 | 5.3 (208) | 4.1 to 6.8 | 3.6 (118) | 2.7 to 4.8 | 3.6 (130) | 2.4 to 5.2 |
| **Proportion of people with reported fever in past 2 weeks that accessed health care within 48 hours (N=353)** | | | | | | | | |
| | 73.4 (259) | 68.0 to 78.1 | 65.2 (92) | 57.0 to 72.7 | 76.1 (70) | 63.8 to 85.2 | 80.8 (97) | 72.2 to 87.3 |
| **Proportion of people with reported fever in past 2 weeks that have been tested for malaria (N=353)** | | | | | | | | |
| | 15.9 (56) | 11.7 to 21.2 | 18.4 (26) | 11.4 to 28.4 | 14.4 (13) | 8.0 to 23.7 | 14.2 (17) | 8.2 to 23.4 |
| **Proportion of people using a net the previous night (N=10,386)** | | | | | | | | |
| Net of any type | 79.9 (8300) | 76.6 to 82.8 | 78.2 (2937) | 71.3 to 83.9 | 86.4 (2664) | 83.0 to 89.2 | 76.1 (2699) | 69.9 to 81.3 |
| ITN* | 28.7 (2978) | 24.2 to 33.6 | 29.5 (1107) | 21.1 to 39.5 | 37.4 (1152) | 29.4 to 46.1 | 20.3 (719) | 14.2 to 28.1 |
| LLIN | 18.9 (1958) | 15.4 to 22.9 | 17.9 (673) | 11.4 to 27.1 | 23.7 (732) | 18.4 to 30.0 | 15.6 (553) | 11.0 to 21.7 |
| **Proportion of households in target area with at least 1 net (N=3300)** | | | | | | | | |
| Net of any type | 92.2 (3300) | 89.9 to 93.9 | 91.8 (1026) | 86.6 to 95.1 | 95.7 (985) | 93.7 to 97.1 | 89.3 (1030) | 84.9 to 92.6 |
| ITN* | 46.5 (3300) | 40.7 to 52.3 | 49.6 (555 ) | 39.2 to 60.2 | 55.8 (574) | 46.6 to 64.6 | 35.0 (404) | 25.6 to 45.8 |

| | TOTAL | | Domain 1 (Thai-Myanmar border) | | Domain 2 (Thai-Cambodia border) | | Domain 3 (Remaining provinces) | |
|---|---|---|---|---|---|---|---|---|
| | % (n) | 95%CI | % (n) | 95%CI | % (n) | 95%CI | % (n) | 95%CI |
| LLIN | 39.4 (3300) | 33.5 to 45.5 | 40.3 (450) | 29.1 to 52.5 | 47.5 (489) | 38.8 to 56.4 | 31.2 (360) | 22.2 to 42.0 |
| **Proportion of households in target area with sufficient net (1 net for every 2 people)** | | | | | | | | |
| Net of any type | 79.1 (3300) | 76.1 to 81.8 | 76.7 (857) | 69.9 to 82.3 | 86.9 (894) | 83.5 to 89.6 | 74.5 (859) | 69.6 to 78.8 |
| ITN* | 28.6 (3300) | 24.5 to 33.0 | 28.3 (316) | 20.9 to 37.1 | 39.8 (409) | 31.8 to 48.3 | 19.0 (219) | 14.0 to 25.2 |
| LLIN | 20.9 (3300) | 17.5 to 24.8 | 18.8 (210) | 12.5 to 27.2 | 29.8 (307) | 23.6 to 36.9 | 15.1 (174) | 10.8 to 20.7 |
| **Proportion of households with sufficient ITN or indoor residual spraying within past 12 months** | | | | | | | | |
| Hh protected | 54.6 (1801) | 49.1 to 60.0 | 51.4 (575) | 41.0 to 61.8 | 73.4 (755) | 65.9 to 79.7 | 40.8 (471) | 31.2 to 51.3 |
| **Proportion of household respondents that received any information about malaria in previous 6 months** | | | | | | | | |
| | 37.5 (1239) | 31.9 to 43.6 | 33.6 (375) | 25.8 to 42.3 | 35.3 (363) | 25.2 to 46.8 | 43.4 (501) | 32.8 to 54.7 |

*****ITN= net treated with insecticide within past 12 months and LLIN

# 1. BACKGROUND

Periodic Malaria Indicators Surveys (MIS) are useful for measuring and monitoring impact of malaria control activities, particularly in settings where routine surveillance systems may not be adequate. Thailand's malaria control programme, established since the 1950s, has developed its own sophisticated malaria surveillance system, and coupled with a marked decline in malaria incidence from its successful programme, has not relied on these periodic large scale MIS.

However, *Plasmodium falciparum* malaria resistant to artemisinin has been reported in Thailand. Thailand has recently embarked on the elimination of *Plasmodium falciparum* funded by GFATM and developed a National Malaria Strategy for Control and Elimination of Malaria (2011-2016). Unlike malaria control, elimination will require a different programmatic mind-set as well as new tools for monitoring and evaluation. Therefore, Thailand requires a survey to determine baseline information on malaria to monitor progress and evaluate implementation according to WHO guidelines.

The National Malaria Programme's overall goal is to reduce malaria morbidity and mortality and move towards the elimination of malaria parasites in Thailand, with the following five objectives:

1. To **detect malaria cases (both asymptomatic and symptomatic)** and ensure effective diagnosis and treatment and gametocyte clearance;
2. To **prevent transmission** of malaria parasites through effective vector control and personal protection measures among vulnerable populations;
3. To support elimination of malaria parasites through comprehensive behavior change communication, community mobilization and advocacy;
4. To provide **an effective management system** (including surveillance, monitoring and evaluation, and operational research) to enable rapid and high quality implementation of the strategy; and
5. To interrupt malaria transmission in target districts.

A key component of the National Malaria Monitoring and Evaluation Plan is to conduct malaria indicator surveys (including Malariometric, prevention and treatment-seeking coverage and behavior) at the household level, which will be undertaken in Years 1 and 5 of the GFATM Round 10 malaria grant. A separate mid-term evaluation of knowledge, attitudes, and practices (KAP) is planned for year 3.

It was expected that this survey will serve as baseline for the consolidated Global Fund SSF Performance Framework (GF Round 7 and 10); contribute to data for the Global Plan for Artemisinin Resistance Containment (GPARC) framework, and other regional and global M&E frameworks; monitor critical milestones and indicators for the project and programme; as well as provide key evaluation data for the International Task Force (ITF) for refinement and improvement of the implementation of the containment of artemisinin resistance strategy.

The malaria indicator survey was undertaken in the targeted 43 provinces (A1 and A2 areas) of the consolidated GF-SSF grant, with the aim of monitoring progress of containment interventions in

Thailand along the Thai-Cambodia border and intensified malaria control activities along the Thai-Myanmar border and non-border provinces. The survey area was divided into three domains according to geographic location and malaria epidemiology.

**Distribution of Provinces in the three geographical domains**

| Domain 1: Thai Myanmar border (10 provinces) | Domain 2: Thai Cambodia border (7 provinces) | Domain 3: (26 provinces) |
|---|---|---|
| 1. Kanchanaburi | 1. Chanthaburi | 1. Chonburi |
| 2. Chumporn | 2. Trat | 2. Pangnga |
| 3. Chiang Mai | 3. Si Sa Ket | 3. Rayong |
| 4. Tak | 4. Srakaeo | 4. Surat Thani |
| 5. Prachaubkirikan | 5. Surin | 5. Krabi |
| 6. Petchuburi | 6. Ubon Ratchathani | 6. Nakhon Sri Thammarat# |
| 7. Mae Hong Son | 7. Burirum | 7. Phrae |
| 8. Ranong | | 8. Mukdahan |
| 9. Ratchuburi | | 9. Supanburi |
| 10. Chiang Rai | | 10. Uthai Thani |
| | | 11. Kamphaeng Phet |
| | | 12. Chachoengsao |
| | | 13. Trang |
| | | 14. Nakhon Ratchasima |
| | | 15. Nan |
| | | 16. Prachinburi |
| | | 17. Phatthalung |
| | | 18. Phitsanulok |
| | | 19. Phetchabun |
| | | 20. Lamphang |
| | | 21. Lamphun |
| | | 22. Songkhla |
| | | 23. Narathiwat |
| | | 24. Yala |
| | | 25. Satun |
| | | 26. Uttaradit |

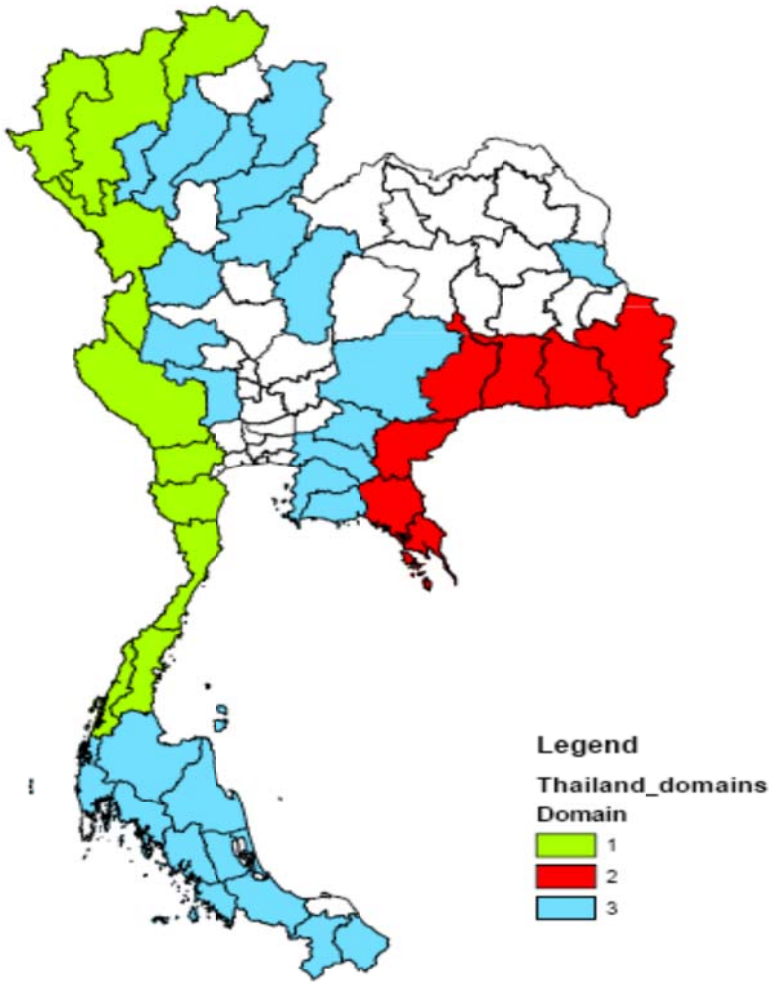
In Thailand, villages are stratified into 4 categories:

- A1 - perennial transmission area (transmission reported for at least 6 months per year)
- A2 - periodic transmission area (transmission reported but for less than 6 months per year)
- B1 - high and moderate receptivity (transmission not reported within the last 3 years but primary and secondary vectors present)
- B2 - low and no receptivity (transmission not reported within the last 3 years and primary and secondary vectors absent, suspected vector may be present)

Considering that B1 and B2 areas have no malaria transmission, this survey was limited to A1 and A2 villages, which include provinces along the borders with Cambodia and Myanmar. In addition, clusters bordering Myanmar were over sampled considering the lack of information on malaria in this area, higher malaria transmission and artemisinin resistance issues. For seasonality, Domain 1 transmission peaks in May-July, with a small peak in Jan or Oct-Nov (SMRU presentation in informal

meetings); Domain 2 transmission peaks in May-July & Oct-Jan (Xulan Fu's dissertation 2011, unpublished result, London School of Hygiene & Tropical Medicine).

**Map of TMS 2012 Domains**



**Objectives of the Survey**

The survey primary objectives were as following:

1. Address specific outcome indicators for the Malaria Global Fund Single Stream Funding (SSF-M) about malaria knowledge, attitudes, and practices of people in 43 provinces.
2. To provide an estimate of malaria prevalence using Polymerase Chain Reaction (PCR) and serological measures as a baseline to monitor malaria transmission in an elimination setting.

Specific indicators to be addressed by the TMS 2012 included:

- Parasite and PCR prevalence in A1 and A2 target areas
- Overall serological prevalence in A1 and A2 target areas
- Proportion of households in target areas with at least one LLIN/ITN per 2 persons
- Proportion of population at risk sleeping under an ITN/LLIN the previous night
- Proportion of household respondents in malaria risk areas (A1 + A2) who can recall at least 1 key message on malaria control and containment/elimination

# 2. METHODS

Survey Design and Sampling

This was a cross sectional household survey using a stratified multi-stage cluster sampling approach where "cluster" was defined as "village". The strata were defined according to geographical area (Thai Myanmar, Thai Cambodia borders and remaining provinces) and malaria endemicity (A1 and A2 area). Each geographical stratum was considered as a survey domain where similar numbers of clusters were included across A1 and A2 area. Clusters were sampled using probability proportionate to size method, using a list of all villages categorized as A1 and A2 in each geographical area. In the second stage, an equal number of households were selected in each cluster using simple random sampling. All households were eligible for inclusion. All family members regardless of nationality and migrant status, and overnight visitors residing at the household were all included for blood testing. There were very few exclusion criteria for the prevalence survey (blood testing).

Exclusion criteria:

- Infants less than 6 months of age
- Any seriously ill individual (i.e., in need of hospital/medical care)
- Any abnormal blood coagulation.

**Summary of sampling for each domain**

| Number of clusters selected | **Domain 1** | **Domain 2** | **Domain 3** |
|---|---|---|---|
| **A1** | 14 | 13 | 15 |
| **A2** | 14 | 13 | 14 |
| **Total** | 28 | 26 | 29 |

Migrants and mobile populations are often most vulnerable and most difficult to sample from. Although this survey attempted to include questionnaires for mobile populations (including temporary visitors and those who go to the forest) present in sampled households on the survey day, the design of the survey was not intended to specifically address this population for which more specialized survey methodologies may be needed.

Sample size

The sample size for the household survey has been determined assuming a non-response rate of 5%, a design effect of 2.0 and an average household size of 4. An explanation of the statistical parameters used in detail, along with an explanation of the cluster and sampling design can be found in annexe.

**Specific statistical measurements used for each domain sample size**

| | Domain 1 | Domain 2 | Domain 3 |
|---|---|---|---|
| Anticipated prevalence | 1.5% | 1.0% | 0.5% |
| Precision | 0.00525 | 0.0045 | 0.003 |
| Sample size (# of hh) | 1126 | 1027 | 1161 |
| Number of clusters | 28.1 | 25.7 | 29 |
| Hh per clusters | 40 | 40 | 40 |
| Relative standard error | 0.35 | 0.45 | 0.6 |
| 95%CI | 0.45 – 2.55% | 0.10 – 1.90% | 0.00 – 1.10% |
| Cluster rounding | 28 | 26 | 29 |

With this cluster rounding, the final number of households per domain (sample size) result in:

Domain 1 = 1120 HH

Domain 2 = 1040 HH

Domain 3 = 1160 HH

For a total of 3320 households in 83 clusters (villages).

Malaria prevalence survey

The prevalence of P. falciparum and P. vivax infection was estimated by a blood survey using microscopic examination of Giemsa-stained blood smears that was performed in order to determine the presence of malaria parasites in survey participants (2-3 drops of blood per participant). In addition, molecular analysis (PCR) was used to measure and identify sub-microscopic infections as well as serological measurements to detect recent infections with malaria – potentially an important measurement in a country like Thailand where malaria transmission is low. Finally, blood samples were collected on filter paper (4 drops) to determine G6PD deficiency prevalence and for future screening of potential molecular markers and genotyping for drug resistance. Microscopic examinations of Giemsa-stained blood smears were performed to determine the presence of malaria parasites. An extensive training and quality assurance programme was implemented to best ensure accuracy of prevalence data. Blood takers were trained in smear preparation and smear staining procedures as well as preparation of filter paper for PCR and serology, prior to the start of data collection.

Design of survey tools

The standard questionnaires used for the Thailand Malaria Survey was based on those previously tested and used in Cambodia (2009 and 2010) and Myanmar (2011) surveys in the areas targeted along the border for containment of artemisinin resistance to maintain standardization of methodology and results. Some modifications were made to address specific project indicators as well as the Thailand context. This questionnaire was translated and validated through a pre-test which took place prior to implementation.

Workshop of field teams

Interviewers were carefully selected so that they were culturally and socially acceptable. They had good working knowledge of local languages. A three day workshop was held prior to the field work. A detailed guide with the standard operating procedures was prepared to support the field team while conducting the interviews. The guide provided key ideas to interviewers on the conduct of interview and procedures to be followed by each team member. The workshop also included an extensive training and refresher training in universal precaution procedures, smear preparation and staining procedures for blood collectors. Microscopists were required to pass a blinded practical qualifying examination before reading smears obtained from the survey.

Community sensitization

After the clusters were sampled, the local authorities and community leaders were informed of the purpose and expected time of the survey. The investigators coordinated with the staff at VBDCs and VBDUs in the selected areas, and also the head of selected villages or sub-districts and asked their consent and authorization to implement the survey.

Field work

Data collection occurred between mid-November 2012 and February 2013, after the end of the rainy season when malaria transmission is the highest. The target of the interview was the female head of household. If no female respondent was available at the household, a male respondent was interviewed instead. Households with individuals absent during the time of the initial visit were revisited by the survey team up to three times. Seven teams of 12 members each visited the clusters (villages) for a maximum of 2 days and one night to ensure complete data collection for all members of the household selected for blood collection. The team composition was as follows:

- 1 survey supervisor
- 4 household interviewers (with relevant local language skills)
- 4 blood takers (trained Vector-Borne Disease Center/Unit staff and additional trained staff as needed)
- 1 supervisory technician
- 2 drivers

It was estimated that each team would spend 24 working days in the field, which, including weekends, amounting to about 30 days of field work. The supervisors had to report daily to the assessment coordinator on any difficulty faced. They sat down with the team members after every day of data collection to go through every questionnaire and make sure they were complete and accurately filled it in. They also directly supervised the interviewers while performing household interviews.

Blood collectors used universal precaution procedures to draw blood from participants, including wearing gloves and using disinfectants prior to blood collection. Household members were requested to give a total of approximately 6 drops of blood from a finger prick (finger to be cleaned with an alcohol swab and allowed to air dry prior to prick) to be collected on microscope slides (2 drops) and filter paper (4 drops) and labelled with an assigned identification code/number. The filter paper was used for standard PCR assays to detect P.falciparum and P. vivax infection, for serological assay to identify past infections, glucose 6-phosphate dehydrogenase deficiency (G6PD) status, and for screening of potential molecular markers and genotyping for drug resistance. Following standard blood collection protocols, sterilized lancets were safely disposed of.

Blood slides were sent to the closest health facility (Vector Borne Disease Centre or Malaria Clinic) with capacity for microscopy reading. All smears were double-read and those judged positive by these readers, as well as discrepant readings, were re-checked by a senior microscopist at BVBD, who was blinded to the results of the first reader. Additionally, 10% of all smears judged negative were double-checked by a senior microscopist. In both cases, the senior microscopist reading was used in the event of non-concordance with the first reader.

PCR was conducted by Chiang Mai University to differentiate Pf and Pv infection using standard PCR assays. Samples were assayed against MSP-119 and AMA antigens for both Plasmodium falciparum and P. vivax. These antigens were used successfully in previous malaria surveys in Cambodia, and were chosen as they are reasonably immunogenic.  Antibody levels were determined by ELISA in Immulon4 96 well plates.

Data entry and analysis

All information collected was entered using EpiData software with the exception of slide readings which were recorded in Microsoft Excel. The data set was transferred to Stata version 10.1 (StataCorp LP, College Station, TX, USA) for consistency checks and preparation for analysis. Data were then re-coded and key indicators generated using pre-defined definitions. After this re-code stage, all household data analysis were adjusted for the survey design, i.e. clustering, and sample strata and sample weights at the household level were applied as appropriate. Analysis focused on key indicators providing overall estimates by background characteristics including domain, risk category and socioeconomic status (wealth quintiles). A wealth index was obtained for each household in the survey based on household characteristics and assets using principal component analysis (PCA). All variables input to the PCA were itemized and the first component was used as the wealth index. Households were then classified into five wealth index quintiles and these were used as the relative socioeconomic groups. The household quintile was applied to an individual for individual level analysis.

Sample weights

Within each geographical domain, the sampling of clusters was non-proportional across risk categories (A1 / A2); therefore the sample data was non-self-weighting. All survey analysis

accounted for sample weights within each domain together with adjustment for clusters and sampling strata, i.e. risk category strata.

Ethical considerations

Individual informed consent was sought from all respondents before interviews were conducted. Before each interviewee was asked to give consent, the interviewer gave a brief description of the study objectives, the data collection procedure, the expected benefits, and the voluntary nature of participation at all stages of the interview. Community consent was obtained by holding a meeting with the village and commune leaders prior to the scheduled visit to the study villages, informing them of the purpose and procedures involved and obtaining their agreement. Assurances were given to all participants that data would be kept private and confidential.

For children from 6 months to 18 years, consent for blood testing was obtained along with parental consent and all consents were witnessed. The consent process, information sheet and consent were approved by the Ethics Committee of the department of disease control of the Thai Ministry of Public Health. Blood drawing procedures were performed by the technicians from VBDU and were thus trained to reach the standards of the Vector-Borne Disease units. All staffs involved in blood testing of children were specifically trained on the consent process and tools to use for children below 18 years old. Refusal rates were recorded.

Participants with symptoms of malaria or fever within the past two weeks were tested using the combo Rapid Diagnosis Test (RDT), and malaria positive patients were provided with anti-malarial drug treatment based on the national programme treatment guidelines or referred to a health facility as appropriate. Pregnant women who were smear positive were referred to the nearest health facility for treatment.

Camp survey

Data were also collected among the population living in three refugee camps, in Tak province. These camps are named Mae La, Nupo and Umpien. They include a total of 78,000 registered families and are covered by the GFR10 project. The sampling methods were similar to the household survey. First, 15 sections based upon registration listing were selected using proportionate to size technique and in a second stage, 15 households were sampled using simple random sampling methods. The total sample size was thus 225 households. Key indicators included net ownership and use and coverage of BCC intervention. Data were collected using a different protocol, contractor and ethical approval process than those of the general Thai population.

# 3. RESULTS

*Issues to consider for the interpretation of the results:*

**Representativeness:** The intention of this data collection was to obtain information from households on malaria prevalence and other malaria indicators that would be statistically representative of the population living in area with ongoing malaria transmission in Thailand. In order to achieve such representativeness, the sampling methodology involved a two stage cluster sampling which is similar to those used in standard national surveys as Malaria indicator cluster Surveys (MICS) and Demographic Health Surveys (DHS).

**Accessibility:** Out of the 83 clusters, 78.3% (n=65) had any household replaced because householders were absent on three different visits. The average number of households replaced was 11.0 (ranging from 1 to 26) or more than a quarter of the cluster. Household replacement was more frequent at Myanmar border as shown in the table below:

| | Overall (N=83) | Myanmar border (N=28) | Cambodia border (N=26) | Remaining provinces (N=29) |
|---|---|---|---|---|
| Any hh replacement in cluster | 78.3% (65) | 85.7% (24) | 57.7% (15) | 89.7% (26) |
| Mean hh replaced | 11.0<br>(1 to 26) | 14.2<br>(3 to 26) | 8.6<br>(1 to 24) | 9.5<br>(4 to 18) |

Replacement was done by randomly selecting another household in that cluster, therefore within the same malaria transmission category. However, one could expect that householders absent for longer period of time to be more exposed to malaria. Consequently, it is possible that the true malaria prevalence in clusters with higher household replacement rates was under estimated.

## 3.1 CHARACTERISTICS OF THE SAMPLE

**Table 3.1.1 Denominators for households, sampled individuals and household nets**

| | TOTAL | Domain 1 Thai-Myanmar border | Domain 2 Thai-Cambodia border | Domain 3 Remaining provinces |
|---|---|---|---|---|
| | N (100%) | N (%) | N (%) | N (%) |
| Households | 3300 | 1118 (33.9) | 1029 (31.1) | 1153 (34.9) |
| People in households | 10,834 | 3940 (36.4) | 3251 (30.0) | 3643 (33.6) |
| Under 5 years | 694 | 280 (40.4) | 189 (27.2) | 225 (32.4) |
| 5 to 14 year olds | 1670 | 705 (42.3) | 485 (29.0) | 480 (28.7) |
| Male adults, 15+ years | 4090 | 1381 (33.8) | 1270 (31.0) | 1439 (35.2) |
| Female adults, 15+ years | 4279 | 1532 (35.9) | 1275 (29.7) | 1472 (34.4) |
| Currently pregnant (% of all eligible women) | 174 | 92 (53.0) | 22 (12.6) | 60 (34.4) |
| Household nets:<br>Any type of mosquito net<br>ITN *<br>LLIN** | 7563<br>2720<br>1974 | 2718 (36.0)<br>992 (36.5)<br>671 (34.1) | 2525 (33.3)<br>1089 (40.0)<br>783 (39.6) | 2320 (30.7)<br>639 (23.5)<br>520 (26.3) |
| People who go to the forest and sleep overnight | 1499 | 335 (22.4) | 374 (24.9) | 790 (52.7) |
| People who travel and sleep away from home (past 6 months) | 903 | 448 (49.7) | 271 (29.9) | 184 (20.4) |
| Temporary visitors in the household | 99 | 52 (52.6) | 25 (25.2) | 22 (22.2) |
| People with mobile activity (forest goers, travellers or temporary visitors)*** | 2201 | 768 (35.0) | 553 (25.1) | 880 (40.0) |
| People who reported fever in the previous two weeks | 456 | 208 (45.7) | 118 (25.8) | 130 (28.5) |
| Blood samples taken for microscopy | 10830 | 3937 (36.4) | 3250 (30.0) | 3643 (33.6) |

* ITN = insecticide-treated net, which includes nets treated within the past year and LLINs
** LLIN = long lasting insecticide-treated net, based on brand
***As defined in this survey

Overall, 3,300 households were sampled across three geographical domains, with equal sample size, amongst villages with ongoing malaria transmission, either perennial or periodic. Households at Thai Myanmar border were more populated; there were more children under five and pregnant women, compared to the two other domains. There were only 27% under fives amongst household members at the Thai Cambodia border and there were less pregnant women (12.6% vs 53.0% in Domain 1 and 34.4% in Domain 3), meaning the population living at the Thai Cambodia border tended to be older. Nets of any type were more likely to be found at the Thai Myanmar border while ITN and LLIN were more likely to be found at the Thai Cambodia border. A total of 2,201 mobile populations were found on the survey day in the sampled households, defined as forest goers (1,499), temporary visitors (99) and travellers (903). Forest goers were more concentrated in Domain three (52.7% vs 2.4 and 24.9) while travellers and visitors were more likely to be at the Thai Myanmar border with

49.7 and 52.6% respectively. An episode of fever in the past 2 weeks was reported by 456 individuals and these were more concentrated at the Thai Myanmar border (45.7%).

**Table 3.1.2 Age and sex distribution of residents, visitors, people who travel away from home, and people who go to the forest**

| | TOTAL | < 5 years | 5-14 years | 15+ years Males | 15+ years Females | Missing |
|---|---|---|---|---|---|---|
| | N | % (N) | % (N) | % (N) | % (N) | % (N) |
| Usual residents | 10,542 | 6.4 (673) | 15.6 (1643) | 37.7 (3973) | 39.5 (4159) | 0.9 (94) |
| Temporary visitors | 99 | 7.1 (7) | 5.1 (5) | 44.4 (44) | 41.4 (41) | 2.0 (2) |
| Travel away from home | 903 | 2.5 (23) | 9.8 (88) | 50.8 (459) | 36.0 (325) | 0.9 (8) |
| Go to the forest | 1499 | 0.2 (3) | 1.2 (18) | 64.3 (964) | 34.3 (514) | - |
| **Domain 1 (Thai-Myanmar border)** | | | | | | |
| Usual residents | 3819 | 7.1 (271) | 18.1 (690) | 34.9 (1333) | 38.9 (1487) | 1.0 (38) |
| Temporary visitors | 52 | 7.7 (4) | 7.7 (4) | 38.5 (20) | 44.2 (23) | 1.9 (1) |
| Travel away from home | 448 | 1.6 (7) | 13.6 (61) | 48.2 (216) | 35.3 (158) | 1.3 (6) |
| Go to the forest | 335 | - | 1.2 (4) | 78.8 (264) | 20.0 (67) | - |
| **Domain 2 (Thai-Cambodia border)** | | | | | | |
| Usual residents | 3167 | 5.7 (182) | 15.2 (480) | 39.1 (1239) | 39.1 (1237) | 0.9 (29.0) |
| Temporary visitors | 25 | 4.0 (1) | - | 48.0 (12) | 44.0 (11) | 4.0 (1) |
| Travel away from home | 271 | 4.4 (12) | 7.4 (20) | 51.3 (139) | 36.5 (99) | 0.4 (1) |
| Go to the forest | 374 | 0.8 (3) | 3.2 (12) | 65.2 (244) | 30.7 (115) | - |
| **Domain 3 (Remaining provinces)** | | | | | | |
| Usual residents | 3556 | 6.2 (220) | 13.3 (473) | 39.4 (1401) | 40.4 (1435) | 0.8 (27) |
| Temporary visitors | 22 | 9.1 (2) | 4.5 (1) | 54.5 (12) | 31.8 (7) | - |
| Travel away from home | 184 | 2.2 (4) | 3.8 (7) | 56.5 (104) | 37.0 (68) | 0.5 (1) |
| Go to the forest | 790 | - | 0.3 (2) | 57.7 (456) | 42.0 (332) | - |

Overall, individuals with mobile activity tended to be adult males and this was particularly marked for forest goers and was true in all three domains. Reasons for travelling away from home were assessed amongst travellers as illustrated in Figure 3.1.1; 37.5% said they travelled for work, 23.5% to visit relatives, 20.8% for another reason, 10.2% for travelling and 8.0% to study. There were more people travelling for work in Domain three, suggesting that there are more work opportunities in this area, which is coherent with the higher proportion of forest goers (52% in these villages) .

**Figure 3.1.1 Reasons for travelling away from home amongst travellers (N=903)**

*Multiple answers possible.*

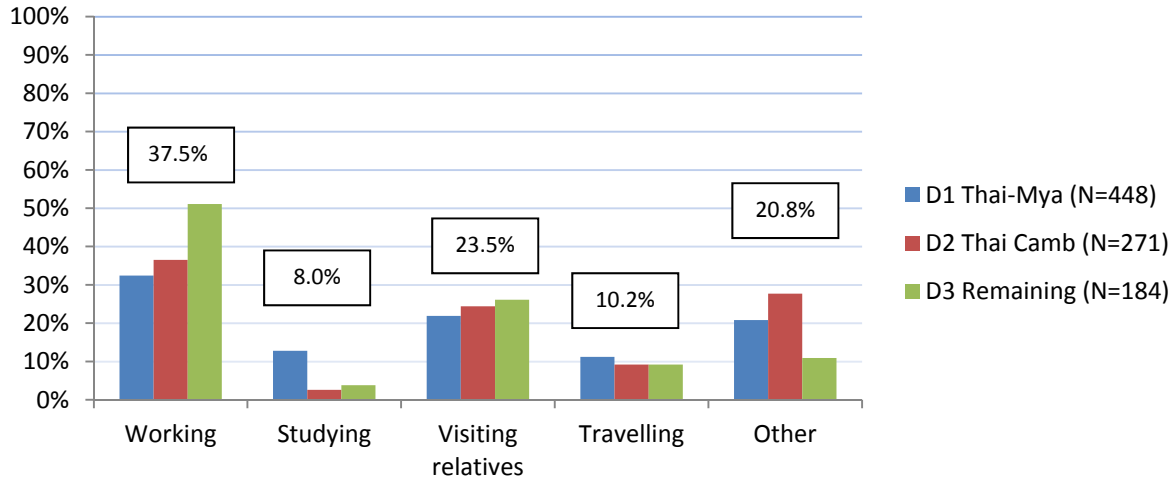



**Table 3.1.3 Details of temporary visitors in households**

| Temporary Visitors | TOTAL N=99 | Domain 1 (Thai-Myanmar border) N=52 | Domain 2 (Thai-Cambodia border) N=25 | Domain 3 (Remaining provinces) N=22 |
|---|---|---|---|---|
| | % (N) | % (N) | % (N) | % (N) |
| **Nationality** | | | | |
| Thai | 83.8 (83) | 78.8 (41) | 80.0 (20) | 100 (22) |
| M1 | 11.2 (11) | 21.2 (11) | - | - |
| M2 | - | - | - | - |
| Don't know | 5.0 (5) | - | 20.0 (5) | - |
| **Length of time in the village** | | | | |
| < 1 week | 51.5 (51) | 65.4 (34) | 24.0 (6) | 50.0 (11) |
| 1 week to 1 month | 16.2 (16) | 25.0 (13) | 4.0 (1) | 9.1 (2) |
| > 1 month | 29.3 (29) | 9.6 (5) | 64.0 (16) | 36.4 (8) |
| Don't know | 3.0 (3) | - | 8.0 (2) | 4.5 (1) |
| **Reason to travel in the village** | | | | |
| Work | 22.2 (22) | 9.6 (5) | 56.0 (14) | 13.6 (3) |
| Look for work | 3.0 (3) | 5.8 (3) | - | - |
| Visiting | 59.6 (59) | 69.2 (36) | 36.0 (9) | 63.6 (14) |
| Other | 10.1 (10) | 13.5 (7) | 8.0 (2) | 4.5 (1) |
| Don't know | 5.0 (5) | 1.9 (1) | - | 18.2 (4) |
| **Intention of length of stay** | | | | |
| < 1 month | 48.5 (48) | 59.6 (31) | 20.0 (5) | 54.6 (12) |
| 1 to 6 months | 17.2 (17) | 5.8 (3) | 48.0 (12) | 9.1 (2) |
| Not sure | 34.3 (34) | 34.6 (18) | 32.0 (8) | 36.4 (8) |
| **Intention to travel next** | | | | |
| No plan | 22.2 (22) | 17.3 (9) | 20.0 (5) | 36.4 (8) |
| Return home | 62.6 (62) | 69.2 (36) | 52.0 (13) | 59.1 (13) |
| Other | 8.1 (8) | 13.5 (7) | - | 4.5 (1) |
| Missing | 7.1 (7) | - | 28.0 (7) | - |
| **Travelled abroad during 2011** | | | | |
| Yes* | 7.1 (7) | 9.6 (5) | 8.0 (2) | - |

*****5 visitors travelled to Myanmar and 2 to Cambodia.

Out of the 99 temporary visitors found in the surveyed households, 11 were M1 (arrived less than 6 months ago) and all of them were found at the Thai Myanmar border. Also, temporary visitors at Thai Myanmar border and Domain three were more likely to have arrived less than one week ago and the reason for visit tended to be visiting as opposed to work. There were also less likely to have the intention to stay for more than 1 month. This tells us that mobility pattern was more transient in these areas while visitors at the Thai Cambodia border were more likely to stay for longer period of time. It is worth noting that only 7 visitors reported having travelled abroad during the past year.

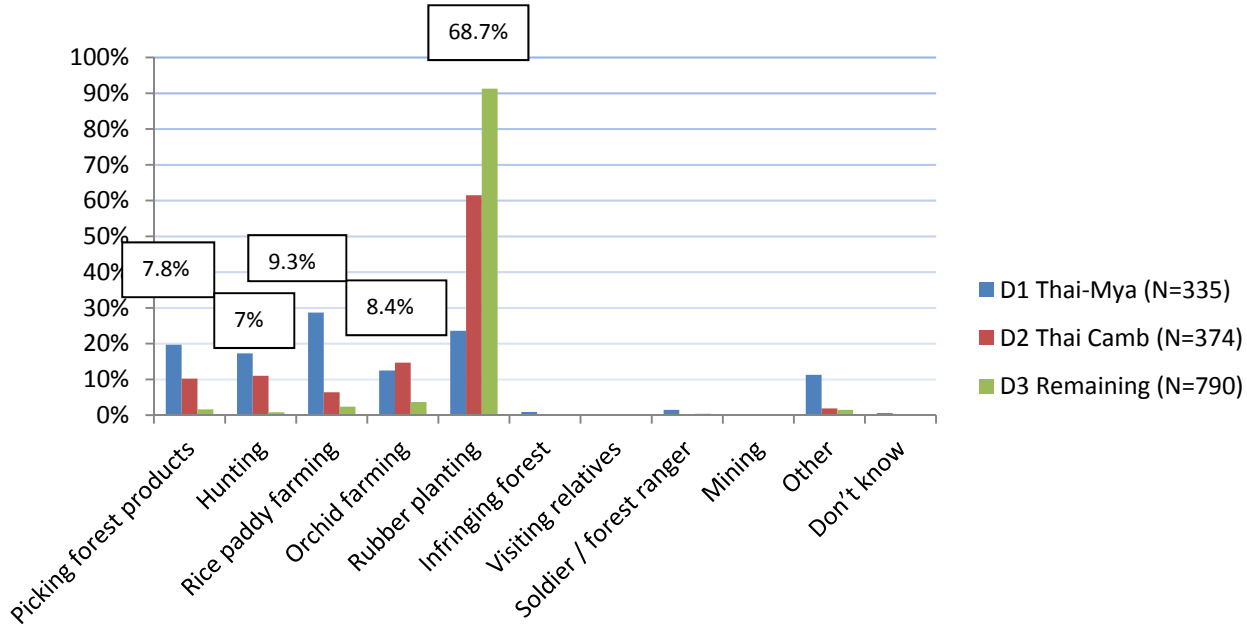
**Table 3.1.4 Details of forest goers**

| | TOTAL N=1499 | Domain 1 (Thai-Myanmar border) N=335 | Domain 2 (Thai-Cambodia border) N=374 | Domain 3 (Remaining provinces) N=790 |
|---|---|---|---|---|
| | % (N) | % (N) | % (N) | % (N) |
| **Last visit to the forest** | | | | |
| Last night | 53.7 (806) | 29.2 (98) | 67.1 (251) | 57.9 (457) |
| < 1 week | 28.6 (429) | 36.1 (121) | 22.7 (85) | 28.2 (223) |
| 1 to 4 weeks | 7.6 (114) | 16.4 (55) | 2.7 (10) | 6.2 (49) |
| ➢ 4 weeks | 8.7 (131) | 15.8 (53) | 5.6 (21) | 7.2 (57) |
| Not sure | 1.3 (19) | 2.4 (8) | 1.9 (7) | 0.5 (4) |
| **Duration of last visit to the forest** | | | | |
| 1 night | 70.5 (1057) | 23.6 (79) | 78.9 (295) | 86.5 (683) |
| 2 or more nights | 19.7 (295) | 45.1 (151) | 15.8 (59) | 10.7 (85) |
| Don't know | 9.8 (147) | 31.3 (105) | 5.4 (20) | 2.8 (22) |
| **Used a net last time in the forest** | | | | |
| Yes | 13.9 (209) | 21.5 (72) | 23.8 (89) | 6.1 (48) |
| No | 85.6 (1283) | 77.9 (261) | 75.1 (281) | 93.8 (741) |
| Don't know | 0.5 (7) | 0.6 (2) | 1.1 (4) | 0.1 (1) |
| **Type of net used (N=209)** | | | | |
| Untreated net | 64.6 (135) | 68.1 (49) | 69.6 (62) | 50.1 (24) |
| ITN net | 33.0 (69) | 27.8 (20) | 28.1 (25) | 49.9 (24) |
| ITN hammock | 1.0 (2) | 1.4 (1) | 1.1 (1) | - |
| Untreated hammock | 1.4 (3) | 2.8 (2) | 1.1 (1) | - |

The high proportion of forest goers that visited the forest recently (either last night or less than a week ago) shows that for most of these individuals, working in forest is a regular activity. This was more true at Thai Cambodia border and in Domain three compared to the Thai Myanmar border. Also, the length of time spent in the forest appears to be short, with 70.5% of these people having spent only 1 night in the forest during their last visit. At the Thai Myanmar border, forest goers tended to spend longer time in the forest with 45.1% spending at least 2 nights in the forest. Overall, only 13.9% used a net the last time they were in the forest and amongst these people, 64.6% used an untreated net.

**Figure 3.1.2 Reasons for visiting the forest (N=1499)**

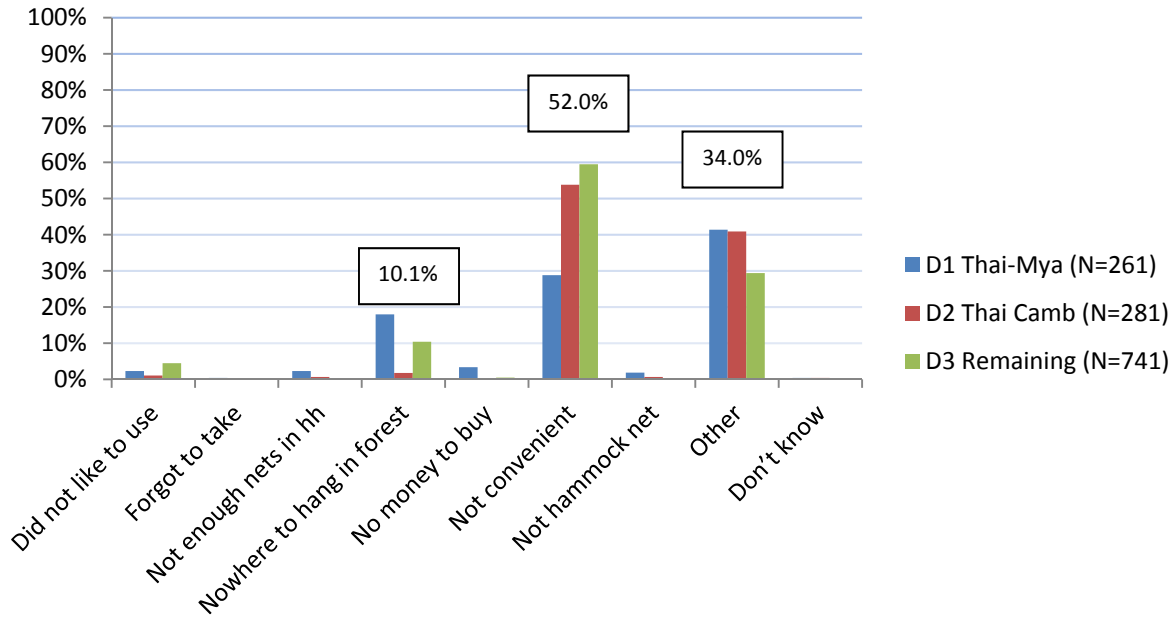
*Multiple answers possible.*




The most common reason for last visit in the forest was rubber planting (68.7%) but this was true only for the Thai Cambodia border and remaining provinces; there were few forest goers visiting the forest for other reasons in these villages. On the other hand, at the Thai Myanmar border, reasons for forest visiting were more diverse and quite similar in proportions than the other domain.

**Figure 3.1.3 Reasons for not using a net when visiting the forest (N=1283)**

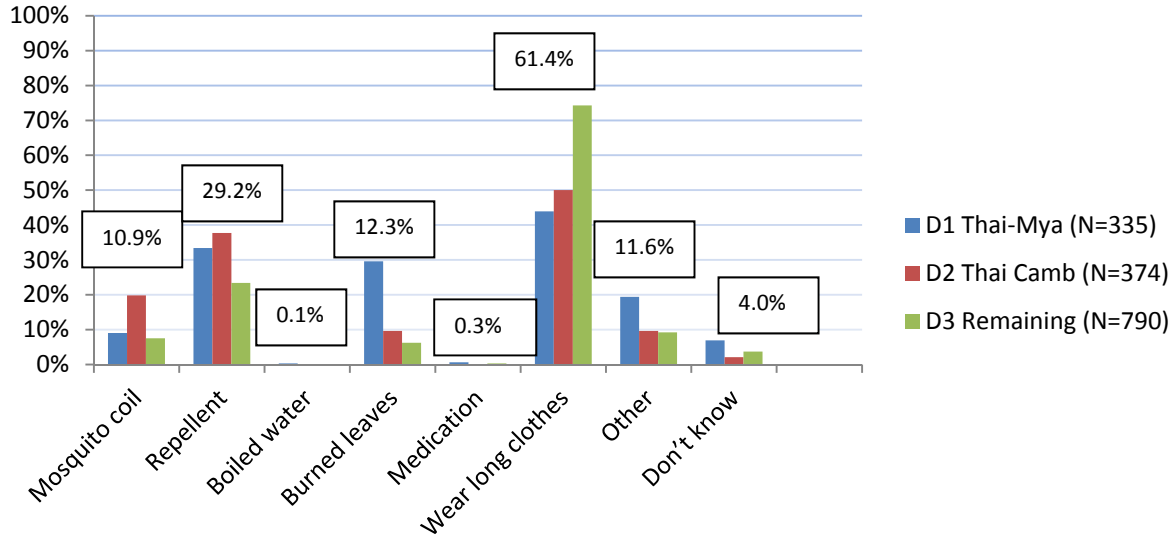
*Multiple answers possible.*



Amongst the 1283 forest goers that did not use a net last time in the forest, the main reasons was that using net is not convenient (52.0%) and that there is nowhere to hang the net in the forest (10.2%). On the other hand, only 3.3% people said they don't like to use nets.

**Figure 3.1.4 Other prevention methods than nets that were used when visiting the forest (N=1499)**

*Multiple answers possible.*




Overall, the three main methods for prevention other than nets that were used during last visit in the forest were wearing long clothes (61.4%), mosquito repellent (29.2%) and burning leaves (12.3%). It is interesting to note that wearing long clothes was more common in Domain three with 74.3%, where net use was the lowest with 6.1% (Table 3.1.4). In Thai Myanmar border, leaves burning was more popular with 29.6%.

## 3.2 MALARIA PREVALENCE AND FEVER

**Table 3.2.1 Malaria prevalence and reported fever by Domain**

| | TOTAL N=10,834 | | Domain 1 (Thai-Myanmar border) N=3,940 | | Domain 2 (Thai-Cambodia border) N=3,251 | | Domain 3 (Remaining provinces) N=3,643 | | P-value* |
|---|---|---|---|---|---|---|---|---|---|
| | % (N) | 95% CI | % (N) | 95% CI | % (N) | 95% CI | % (N) | 95% CI | |
| **Malaria prevalence** | | | | | | | | | |
| Microscopy | 0.0 (2) | 0.0 to 0.1 | -(0) | - | -(0) | - | 0.1 (2) | 0.0 to 0.2 | 0.41 |
| PCR | 0.1 (7) | 0.0 to 0.1 | 0.1 (2) | 0.0 to 0.2 | 0.1 (3) | 0.0 to 0.3 | 0.1 (2) | 0.0 to 0.2 | 0.75 |
| **Prevalence of reported fever in past 2 weeks** | | | | | | | | | |
| Reported fever | 4.2 (456) | 3.5 to 5.2 | 5.3 (208) | 4.1 to 6.8 | 3.6 (118) | 2.7 to 4.8 | 3.6 (130) | 2.4 to 5.2 | 0.10 |

*Comparison across Domain

On the survey day, malaria prevalence based on microscopy the survey day was lower than the 0.5 to 1.5% anticipated. Only two out of the 10,834 individuals in the sampled households were identified as malaria positive by microscopy. Malaria prevalence based on PCR was 0.1% (7 cases). People positive for malaria through PCR were found in all three domains. On the other hand, the prevalence of reported fever cases in the previous two weeks was 4.2%. That proportion was higher at the Thai Myanmar border with 5.3% but the difference across domain was not statistically significant. Although this pattern was not observed for malaria prevalence, it is interesting to note that malaria transmission is higher in that domain compared to the Thai Cambodia border or the remaining provinces.

**Table 3.2.2 Details of malaria positive cases**

| Case | Positive for microscopy / PCR | Species | Any reported fever in past 2 weeks? | Age category | Sex | Risk category | Domain | Socio economic status | Nationality | Mobile activity | Used a ITN last night | Live in hh with 1 ITN per 2 people | Live in hh that received any BCC message |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case 1 | PCR | falciparum | No | + 15 yrs | female | A2 | Thai Cambodia | Middle quintile | Thai | No | No | No | No |
| Case 2 | PCR | vivax | No | + 15 yrs | male | A1 | Thai Cambodia | Poorest quintile | Thai | No | No | No | No |
| Case 3 | PCR | falciparum | No | + 15 yrs | male | A1 | Thai Cambodia | Poorer quintile | Thai | No | No | Yes | No |
| Case 4 | PCR | vivax | No | + 15 yrs | male | A1 | Thai Myanmar | Poorest quintile | M2 | No | No | No | Yes |
| Case 5 | PCR | falciparum | No | + 15 yrs | male | A2 | Thai Myanmar | Poorest quintile | Thai | Works in forest | No | No | No |
| Case 6 | Microscopy + PCR | vivax | No | + 15 yrs | male | A1 | Remaining provinces | Poorer quintile | Thai | Works in forest | No | No | No |
| Case 7 | Microscopy **only** | falciparuum | No | + 15 yrs | male | A2 | Remaining provinces | Richer quintile | Thai | Travels | No | No | No |
| Case 8 | PCR | falciparum | No | + 15 yrs | male | A1 | Remaining provinces | Poorer quintile | Thai | Travels & works in forest | No | No | No |

On the survey day, 7 out of 8 cases were detected by PCR methods while only 2 were identified by standard microscopy. It is worth highlighting that 1 case (case 7) was detected by microscopy but not by PCR. The species pattern identified by PCR was 4 P. falciparum cases and 3 P. vivax cases. There was no case of mixed infection (falciparum + vivax). Interestingly, none of the cases reported any fever episode in the previous two weeks. All were adults above 15 years old, most of them were male and only one was female, not pregnant at that time. As expected, there were more infected people in A1 area as opposed to A2. Most cases were from a poor socio economic background (quintile 1 or 2) and were Thai, compared to only one migrant (M2). Half of the cases reported having an activity involving some exposure to malaria risk such as working in the forest or travelling away from home. None of this people

used an ITN the night before the survey, only one was living in a household with sufficient ITN and one in a household where any BCC message was remembered.

**Table 3.2.3 Determinants of malaria infection and reported fever in previous 2 weeks**

| | Positive slides | | | Reported fever in previous 2 weeks | | |
|---|---|---|---|---|---|---|
| | % (N) | 95% CI | P value | % (N) | 95% CI | P value |
| Domain | | | | | | |
| 1: Thai-Myanmar border | 0.1 (2) | 0.0 to 0.2 | 0.78 | 5.3 (208) | 4.1 to 6.8 | |
| 2: Thai-Cambodia border | 0.1 (3) | 0.0 to 0.3 | | 3.6 (118) | 2.7 to 4.8 | 0.10 |
| 3: remaining provinces | 0.1 (3) | 0.0 to 0.3 | | 3.6 (130) | 2.4 to 5.2 | |
| Risk category | | | | | | |
| A1:perennial transmission | 0.1 (5) | 0.0 to 0.2 | 0.54 | 4.0 (223) | 3.2 to 4.9 | 0.54 |
| A2: periodic transmission | 0.1 (3) | 0.0 to 0.2 | | 4.4 (233) | 3.4 to 5.8 | |
| Age and sex | | | | | | |
| < 5 years | -(0) | - | 0.12 | 12.1 (84) | 9.5 to 15.3 | |
| 5 to 14 years | -(0) | - | | 4.3 (72) | 3.3 to 5.7 | <0.001 |
| Male 15+ years | 0.2 (7) | 0.1 to 0.4 | | 3.3 (136) | 2.6 to 4.2 | |
| Female 15+ years | 0.0 (1) | 0.0 to 0.2 | | 3.5 (150) | 2.8 to 4.3 | |
| Missing | -(0) | - | | 13.9 (14) | 8.6 to 21.6 | |
| Nationality | | | | | | |
| Thai | 0.1 (7) | 0.0 to 0.1 | 0.29 | 4.2 (435) | 3.5 to 5.0 | |
| M1 migrants | -(0) | - | | 4.5 (14) | 2.4 to 8.1 | 0.71 |
| M2 migrants | 1.4 (1) | 0.4 to 4.8 | | 0 (-) | - | |
| Missing | -(0) | - | | 4.9 (7) | 2.2 to 10.5 | |
| Wealth quintile | | | | | | |
| Q1 (poorest) | 0.1 (3) | 0.1 to 0.4 | 0.34 | 5.4 (108) | 3.7 to 7.7 | |
| Q2 | 0.1 (3) | 0.0 to 0.4 | | 4.4 (109) | 3.1 to 6.3 | |
| Q3 | 0.0 (1) | 0.0 to0.3 | | 3.3 (83) | 2.5 to 4.3 | 0.09 |
| Q4 | 0.0 (1) | 0.0 to 0.3 | | 3.4 (79) | 2.7 to 4.4 | |
| Q5 (richest) | -(0) | - | | 5.0 (77) | 3.8 to 6.7 | |
| Forest goers | | | | | | |
| Yes | 0.2 (3) | 0.1 to 0.6 | 0.04 | 3.5 (53) | 2.6 to 4.8 | |
| No | 0.1 (5) | 0.0 to 0.1 | | 4.3 (403) | 3.6 to 5.2 | 0.21 |
| Travellers | | | | | | |
| Yes | 0.2 (2) | 0.1 to 0.9 | 0.08 | 5.0 (45) | 3.7 to 6.8 | 0.24 |
| No | 0.2 (6) | 0.0 to 0.1 | | 4.1 (411) | 3.4 to 5.0 | |
| Temporary visitors | | | | | | |
| Yes | -(0) | - | 0.78 | 2.0 (2) | 0.5 to 7.2 | 0.24 |
| No | 0.1 (8) | 0.0 to 0.1 | | 4.2 (454) | 3.5 to 5.0 | |
| Reported fever in past 2 weeks | | | | | | |
| Yes | -(0) | - | 0.55 | | | |
| No | 0.1 (8) | 0.0 to 0.2 | | | | |
| Used any net the previous night | | | | | | |
| Yes | 0.1 (5) | 0.0 to 0.1 | 0.24 | 4.4 (373) | 3.6 to 5.2 | 0.24 |
| No | 0.1 (3) | 0.0 to 0.4 | | 3.7 (83) | 2.7 to 4.9 | |

The investigation of determinants of malaria prevalence and reported fever revealed that children under five years of age were significantly more likely to be recently affected by an episode of fever (12.1%, p<0.001) while all malaria cases were among adults of more than 15 years old. This confirms that a vast majority of reported fever were non-malaria cases. On the opposite, one would expect more children under 5 years of age among malaria positive cases if there was ongoing transmission in the sampled villages; therefore, the fact that all cases were adults could suggest that these people got infected in another location than their village of residence. On the other hand, poorer households (first and second wealth quintiles) were more likely to be affected by reported fever episode or malaria positivity, which might reflect lower access to health care among these households. Also, it is worth noting none of the malaria cases reported any fever episode in the previous two weeks. This suggests that the symptomatology of these cases differs from the traditional case definition of a suspected malaria case or that cases identified were old infections.

## 3.3 MALARIA PREVENTION

**Table 3.3.1 Household coverage of mosquito screen, IRS and use of repellent**

| | TOTAL N=3300 | | Domain 1 (Thai-Myanmar border) N=1118 | | Domain 2 (Thai-Cambodia border) N=1029 | | Domain 3 (Remaining provinces) N=1153 | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| **Does household use mosquito wire screen** | | | | | | | | |
| Yes | 164 | 5.0 | 98 | 8.8 | 42 | 4.1 | 24 | 2.1 |
| No | 3136 | 95.0 | 1020 | 91.2 | 987 | 95.9 | 1129 | 97.9 |
| **Does household use any chemicals to keep mosquitoes away** | | | | | | | | |
| Yes | 1167 | 35.4 | 386 | 34.5 | 387 | 37.6 | 394 | 34.2 |
| No | 2101 | 63.7 | 723 | 64.7 | 623 | 60.6 | 755 | 65.5 |
| Missing | 32 | 1.0 | 9 | 0.8 | 19 | 1.8 | 4 | 0.3 |
| **Amount of money (in Baht) spent on repellent products during past month (N=1143)** | | | | | | | | |
| 0 | 8 | 0.7 | 6 | 1.6 | 0 | - | 2 | 0.5 |
| 1 to 50 | 508 | 44.4 | 156 | 40.8 | 192 | 50.0 | 160 | 42.5 |
| 51 to 100 | 407 | 35.6 | 135 | 35.3 | 128 | 33.3 | 144 | 38.2 |
| 101 to 200 | 152 | 13.3 | 60 | 15.7 | 44 | 11.5 | 48 | 12.7 |
| 201 or more | 68 | 5.9 | 25 | 6.5 | 20 | 5.2 | 23 | 6.1 |
| **During past 12 months, was the interior walls sprayed against mosquitoes (IRS)?** | | | | | | | | |
| Yes | 1280 | 38.8 | 357 | 32.0 | 572 | 55.6 | 351 | 30.4 |
| No | 1947 | 59.0 | 725 | 64.8 | 437 | 42.5 | 785 | 68.1 |
| Don't know | 73 | 2.2 | 36 | 3.2 | 20 | 1.9 | 17 | 1.5 |
| **Who sprayed the house?** | | | | | | | | |
| Malaria staff | 394 | 54.2 | 183 | 51.3 | 246 | 43.0 | 265 | 75.5 |
| TAO | 134 | 10.5 | 27 | 7.5 | 89 | 15.6 | 18 | 5.1 |
| VHV/VMV | 345 | 26.9 | 86 | 24.1 | 215 | 37.6 | 44 | 12.5 |
| Other | 23 | 1.8 | 22 | 6.2 | 0 | - | 1 | 0.3 |
| Don't know | 84 | 6.6 | 39 | 10.9 | 22 | 3.8 | 23 | 6.5 |

The use of mosquito wire screen was not popular in the sampled population with a household coverage of only 5%. This proportion was slightly higher at the Thai Myanmar border with 8.8%. On the other hand, mosquito repellent products were more common, with overall 35.4% of households using any chemical to repel mosquitoes. This proportion was fairly similar across domains. Most households spent less than 100 Baht on repellent in the previous month. Interestingly, the proportion of households spending more than 100 Baht on repellent was slightly higher at Thai Myanmar border with 22.2% versus 16.7% at Thai Cambodia border and 18.8% in Domain three. Lastly, the overall household coverage of insecticide residual spraying (IRS) was 38.8% and this proportion was much higher at Thai Cambodia border with 55.6%.

**Figure 3.3.1 Knowledge of transmission modes (N=2786)**

*Multiple answers possible.*

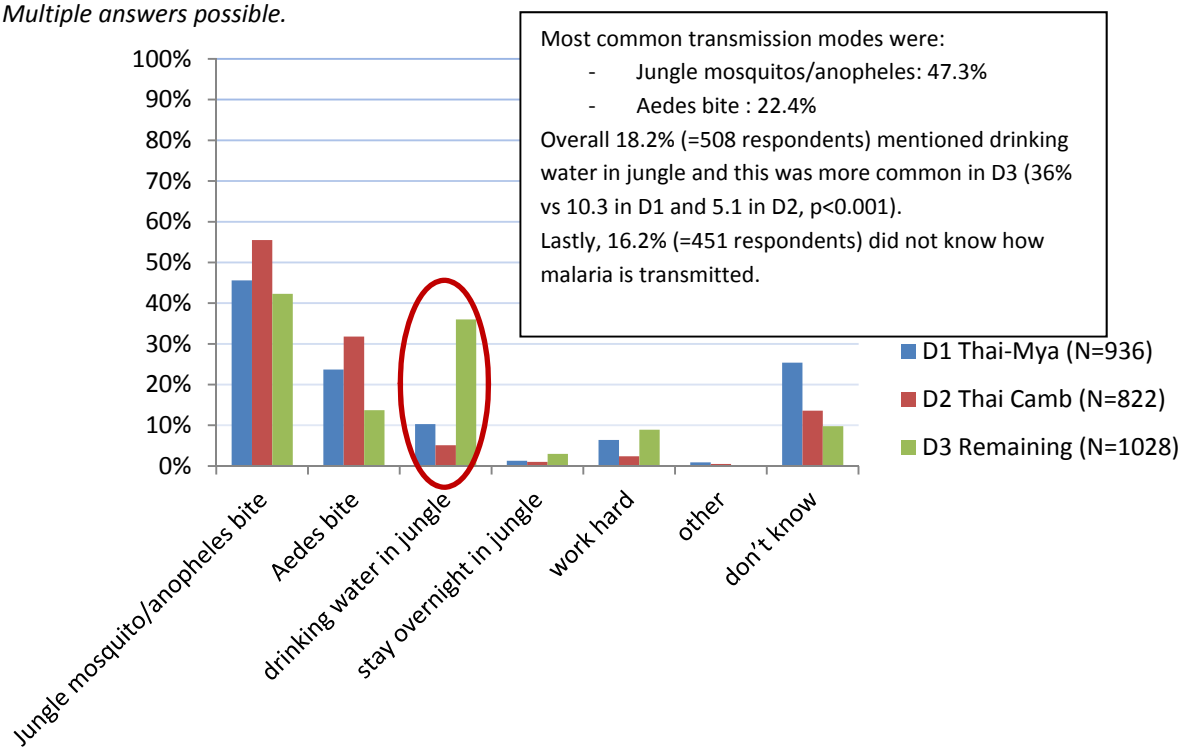


**Figure 3.3.2 Knowledge of prevention methods (N=2786)**

*Multiple answers possible*

Most common prevention methods were:

- Sleep under a net: 75.1%
- Wear long clothes: 21.0%
- Mosquito coil: 20.5%

There were more respondents mentioning using a net in D3 compared to other domains (86% vs 71.2 in D1 and 66.1 in D2, p<0.001). Also, wearing long clothes was more common in D3 (41.4% vs 9.8 in D1 and 8.3 in D2, p<0.001).

Overall, 12.0% (=333 respondents) did not know any method and this proportion was higher in D1 (19.5%) as opposed to D3 (6.1), p<0.001.

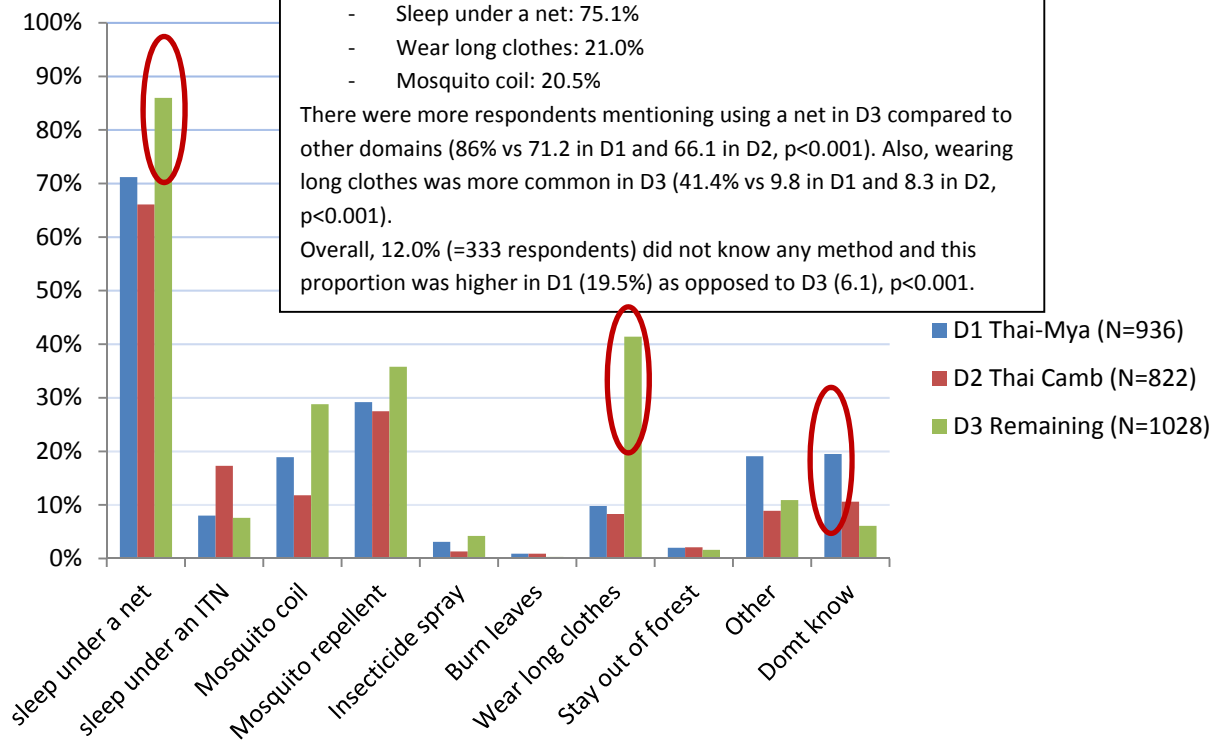



**Figure 3.3.3 Awareness of benefits of using ITN as opposed to untreated nets (N=2786)**

*Multiple answers possible*

Most common benefit answered were:

- Repel mosquito: 55.2%
- Prevent malaria: 19.2%
- Kill mosquito: 13.6%

There were 16.8% (=468 respondents) not knowing any prevention method.

There were significantly more respondents saying "repel mosquito" in D2 (79.9% vs 51.9 in D1 and 44.2 in D3, p<0.001).

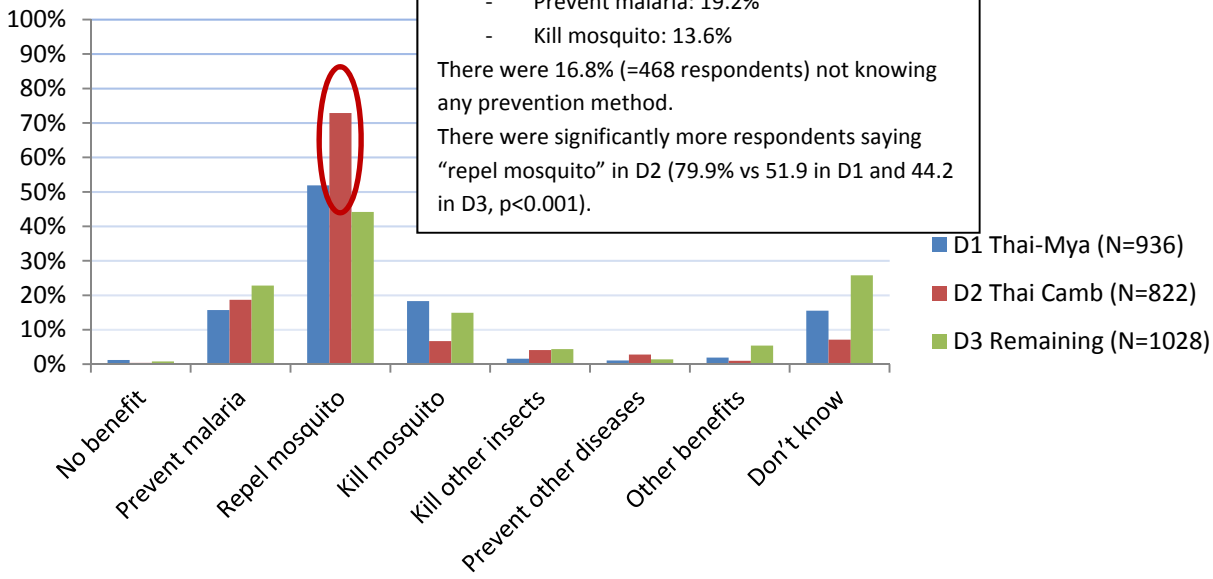


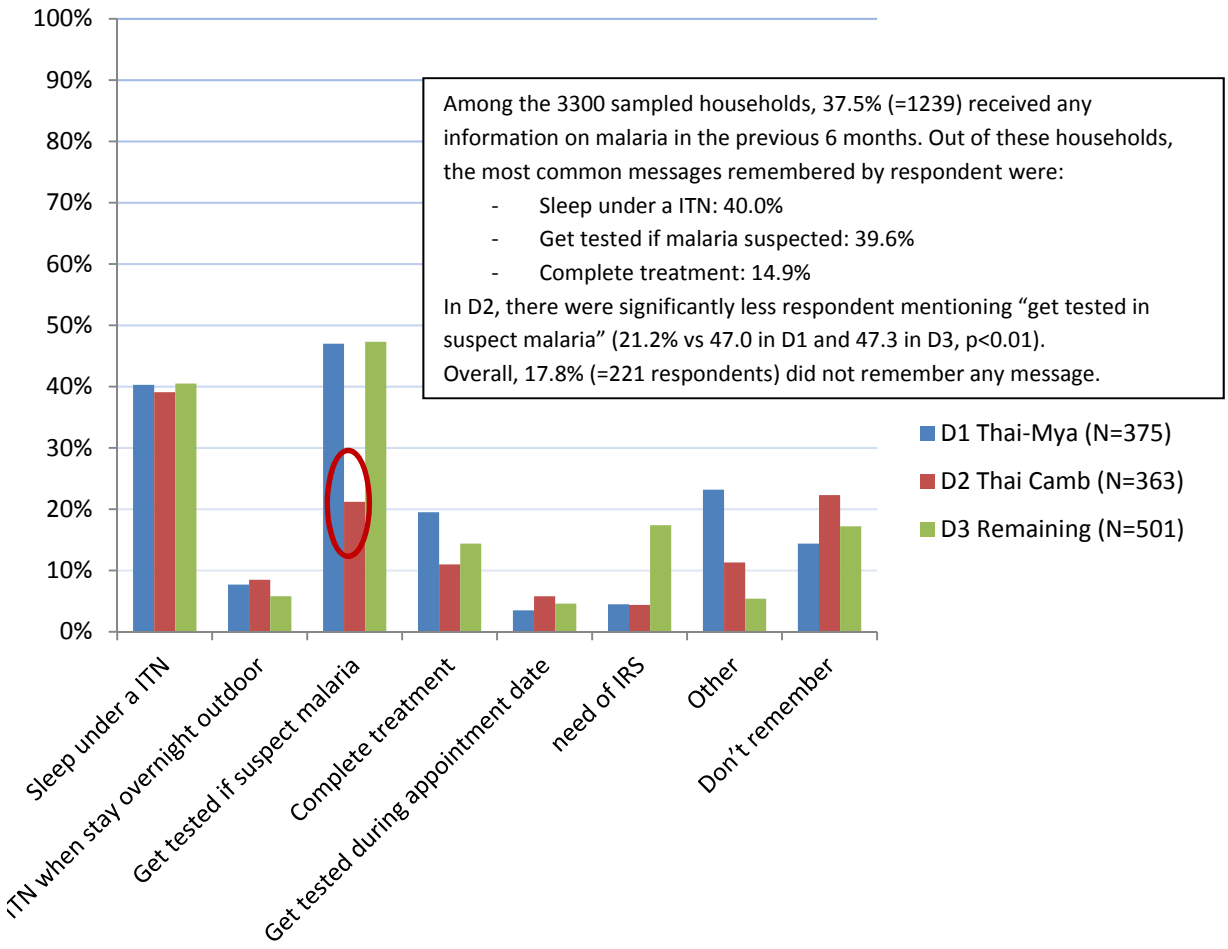
**Table 3.3.2 Summary indicators for household respondent knowledge and awareness of malaria among those who ever heard about malaria (N=2786)**

| TOTAL N=2786 | | Domain 1 (Thai-Myanmar border) N=936 | | Domain 2 (Thai-Cambodia border) N=822 | | Domain 3 (Remaining provinces) N=1028 | |
|---|---|---|---|---|---|---|---|
| % (n) | 95%CI | % (n) | 95%CI | % (n) | 95%CI | % (n) | 95%CI |
| **Received any information in past 6 months (N=all households, 3300)** | | | | | | | |
| 37.5 (1239) | 31.9 to 43.6 | 33.6 (375) | 25.8 to 42.3 | 35.3 (363) | 25.2 to 46.8 | 43.4 (501) | 32.8 to 54.7 |
| **Knows malaria transmitted by anopheles / jungle mosquito or staying in forest** | | | | | | | |
| 48.5 (1351) | 42.6 to 54.4 | 46.2 (432) | 35.8 to 56.8 | 56.3 (463) | 49.0 to 63.4 | 44.4 (456) | 33.5 to 55.7 |
| **Mentioned "net" as malaria prevention method** | | | | | | | |
| 75.1 (2093) | 71.1 to 78.8 | 71.2 (666) | 62.6 to 78.5 | 66.1 (543) | 58.3 to 73.0 | 86.0 (884) | 81.1 to 89.8 |
| **Mentioned "net" + at least 1 other prevention method** | | | | | | | |
| 44.4 (1238) | 40.2 to 48.8 | 38.3 (358) | 31.6 to 45.4 | 25.2 (207) | 19.4 to 32.0 | 65.5 (673) | 57.4 to 72.8 |
| **Mentioned "ITN" as prevention method** | | | | | | | |
| 10.6 (295) | 8.1 to 13.7 | 8.0 (75) | 4.6 to 13.6 | 17.3 (142) | 11.9 to 24.5 | 7.6 (78) | 4.3 to 12.9 |

At the time of the survey, 37.5% of all households had received any information about malaria in the previous 6 months. This proportion was higher amongst domain three even if the difference was not statistically significant (43.4% vs. 33.6% in Domain 1 and 35.3% in Domain 2). Knowledge on net as prevention method was higher in Domain three while knowledge of transmission mode and ITN as prevention methods was higher at Thai Cambodia border, even if insufficient for effective malaria control. This probably reflects the easier access to population living in Domain 3, combined with recent efforts to reduce transmission at Thai Cambodia border.

**Figure 3.3.4 Content of message remembered if received any information in previous 6 months (N=1239)**

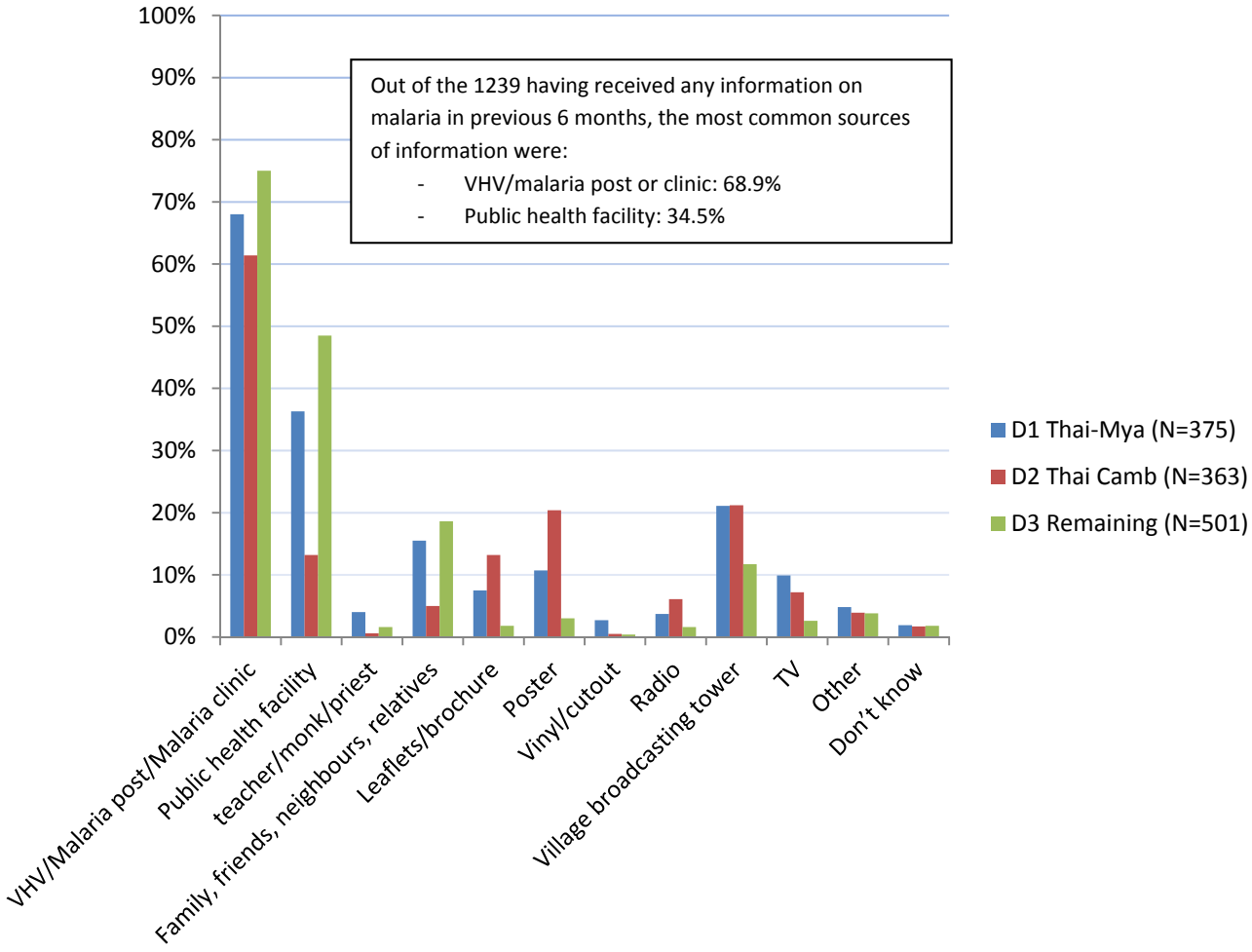
*Multiple answers possible*




The assessment of content of message remembered tells us that case management messaging was more successful at Thai Myanmar border and Domain 3 as opposed to Thai Cambodia border. It is encouraging to observe that the message about ITN use was the most remembered in all domains, especially considering the low awareness of ITN as prevention method amongst all sampled households (10.6%, Table 3.3.2). Caution is required in interpreting these results because the message content in the questionnaire was not the same as messages of BCC strategy in Thailand.

**Figure 3.3.5 Source of information if received any information in previous 6 months (N=1239)**

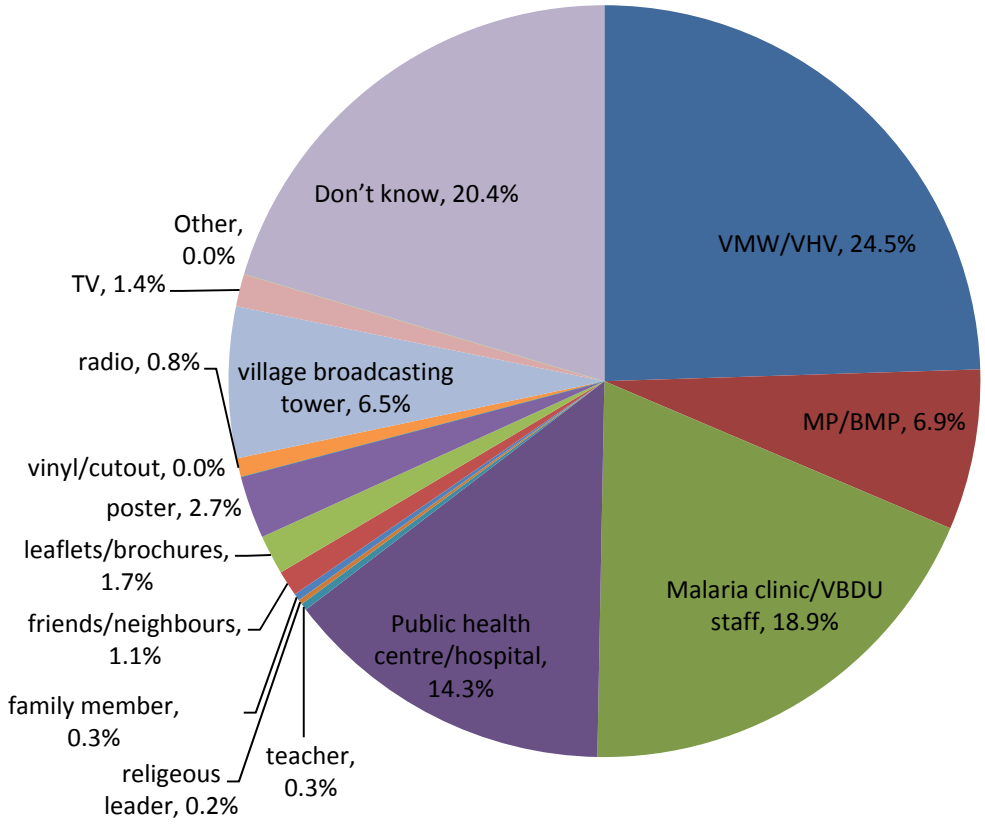
*Multiple answers possible*




While the dominating source of information was health facility staff at the time of the survey, at Thai Cambodia border, sources of message were more diverse and included channels specific to BCC activities such as leaflets and posters. Also, in these villages, there was much less respondents citing public health facilities. On the other hand, information through interpersonal communication with family, friends, relatives or neighbours appears higher in villages with less BCC channels as in Domain 3.

**Figure 3.3.6 First preference of source of information of respondents if received any information in previous 6 months (N=1239)**

*Multiple answers possible*




The pattern of preference of message source was similar to the popularity of information channel and was predominantly health facility staff of health care providers for more than half of respondents.

**Table 3.3.3 Summary of household ownership of mosquito nets**

| | Number of Households | At least one mosquito net | | | | | |
|---|---|---|---|---|---|---|---|
| | | Any Type | | Any ITN | | Any LLIN | |
| | | % (95% CI) | P-value | % (95% CI) | P-value | % (95% CI) | P-value |
| **Total** | 3300 | 92.2 (89.9 to 93.9) | | 46.5 (40.7 to 52.3) | | 39.4 (33.5 to 45.5) | |
| **Domain** | | | | | | | |
| 1 Thai-Myanmar border | 1118 | 91.8 (86.6 to 95.1) | | 49.6 (39.2 to 60.2) | | 40.3 (29.1 to 52.5) | |
| 2 Thai-Cambodia border | 1029 | 95.7 (93.7 to 97.1) | 0.03 | 55.8 (46.6 to 64.6) | 0.01 | 47.5 (38.8 to 56.4) | 0.10 |
| 3 Remaining provinces | 1153 | 89.3 (84.9 to 92.6) | | 35.0 (25.6 to 45.8) | | 31.2 (22.2 to 42.0) | |
| **Risk Category** | | | | | | | |
| A1:perennial transmission | 1673 | 93.5 (91.7 to 95.0) | 0.13 | 49.7 (42.3 to 57.2) | 0.26 | 43.9 (35.9 to 52.2) | 0.12 |
| A2: periodic transmission | 1627 | 90.7 (86.3 to 93.8) | | 43.1 (34.5 to 52.1) | | 34.7 (26.5 to 43.9) | |
| **Socioeconomic Group** | | | | | | | |
| Q1 (poorest) | 659 | 92.4 (82.9 to 96.8) | | 59.2 (46.6 to 70.7) | | 51.5 (39.9 to 62.9) | |
| Q2 | 660 | 95.8 (93.3 to 97.3) | | 54.5 (45.9 to 62.9) | | 48.2 (39.5 to 57.0) | |
| Q3 | 660 | 95.6 (93.6 to 97.0) | 0.01 | 47.0 (39.6 to 54.4) | 0.001 | 38.9 (31.8 to 46.5) | 0.001 |
| Q4 | 668 | 91.6 (88.6 to 93.9) | | 37.6 (31.1 to 44.5) | | 30.7 (24.2 to 38.1) | |
| Q5 (richest) | 653 | 85.3 (80.5 to 89.1) | | 34.0 (28.6 to 39.8) | | 27.6 (22.4 to 33.4) | |

The majority of households (92.2%) owned at least one net of any type at the time of the survey but less than half (46.5%) owned any ITN. Household coverage was higher at Thai Cambodia border and lower in Domain three; this difference was significant for ITN coverage (p=0.01). Net coverage was similar across transmission category for net of any type but LLIN coverage seemed more concentrated amongst perennial transmission area (43.9 vs. 34.7%). Finally, net coverage was significantly associated with wealth, with poorer households being more likely to own a net and this trend was the most marked for LLIN ownership (27.6% in richest quintile vs 51.5% in poorest quintile).

**Table 3.3.4 Summary of household ownership of sufficient mosquito nets**

| | Number of Households | Sufficient Nets (i.e., ≤ 2 people/net) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Any Type | | Any ITN | | Any LLIN | |
| | | % (95% CI) | P-value | % (95% CI) | P-value | % (95% CI) | P-value |
| **Total** | 3300 | 79.1 (76.1 to 81.8) | | 28.6 (24.5 to 33.0) | | 20.9 (17.5 to 24.8) | |
| **Domain** | | | | | | | |
| 1 Thai-Myanmar border | 1118 | 76.7 (69.9 to 82.3) | | 28.3 (20.9 to 37.1) | | 18.8 (12.5 to 27.2) | |
| 2 Thai-Cambodia border | 1029 | 86.9 (83.5 to 89.6) | 0.01 | 39.8 (31.8 to 48.3) | 0.001 | 29.8 (23.6 to 36.9) | 0.01 |
| 3 Remaining provinces | 1153 | 74.5 (69.6 to 78.8) | | 19.0 (14.0 to 25.2) | | 15.1 (10.8 to 20.7) | |
| **Risk Category** | | | | | | | |
| A1:perennial transmission | 1673 | 81.2 (78.1 to 83.9) | 0.13 | 30.4 (25.2 to 36.1) | 0.41 | 23.8 (19.2 to 29.1) | 0.13 |
| A2: periodic transmission | 1627 | 76.9 (71.7 to 81.5) | | 26.8 (20.8 to 33.8) | | 18.0 (13.2 to 24.1) | |
| **Socioeconomic Group** | | | | | | | |
| Q1 (poorest) | 659 | 73.4 (62.6 to 82.0) | | 37.9 (27.2 to 50.0) | | 29.3 (20.4 to 40.2) | |
| Q2 | 660 | 84.4 (80.2 to 87.8) | | 35.6 (29.4 to 42.3) | | 27.9 (22.8 to 33.6) | |
| Q3 | 660 | 85.3 (82.4 to 87.8) | 0.01 | 28.5 (23.3 to 34.3) | 0.001 | 20.1 (15.7 to 25.5) | 0.001 |
| Q4 | 668 | 79.9 (5.7 to 83.6) | | 21.5 (17.7 to 26.0) | | 14.8 (11.7 to 18.6) | |
| Q5 (richest) | 653 | 72.3 (75.7 to 76.8) | | 19.4 (15.8 to 23.7) | | 12.6 (9.5 to 16.4) | |

Household coverage of sufficient net ownership defined as one net for every 2 people was 79.1% for net of any type, 28.6% for ITN and 20.9% for LLIN. This proportion was higher at the Thai Cambodia border and tended to be lower in periodic malaria transmission. The coverage was also pro poor for ITN and LLIN ownership but not for net of any type. This probably reflects the free or subsidized distribution of LLIN while household buy untreated nets at the market.

**Table 3.3.5 Quantity of nets owned by households with at least 1 net**

| | TOTAL N=3300 | Domain 1 (Thai-Myanmar border) N=1118 | Domain 2 (Thai-Cambodia border) N=1029 | Domain 3 (Remaining provinces) N=1153 |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD |
| Usable nets of any type | 2.41 ± 0.04 | 2.51 ± 0.10 | 2.50 ± 0.07 | 2.22 ± 0.06 |
| Unusable nets | 1.67 ± 0.11 | 1.56 ± 0.10 | 1.97 ± 0.27 | 1.34 ± 0.15 |
| Untreated nets | 2.13 ± 0.04 | 2.31 ± 0.08 | 2.13 ± 0.06 | 1.98 ± 0.06 |
| ITN including LLIN | 1.77 ± 0.04 | 1.79 ± 0.09 | 1.90 ± 0.07 | 1.58 ± 0.06 |
| LLIN | 1.52 ± 0.03 | 1.49 ± 0.08 | 1.60 ± 0.04 | 1.44 ± 0.04 |

**Note:** hammock nets were found in only 14 households (< 0.5% of households).

Household respondents reported owning more unusable nets than LLIN (1.67 vs. 1.52). This was true for Thai Cambodia and Thai Myanmar area but not for Domain 3 where the quantity of unusable nets was 1.34 vs. 1.44 LLIN. This is interesting as it could suggest that households are more likely to consider a net unusable in villages targeted by LLIN distribution.

**Table 3.3.6 Details of all household nets**

| | TOTAL N=7566 | | Domain 1 (Thai-Myanmar border) N=2721 | | Domain 2 (Thai-Cambodia border) N=2525 | | Domain 3 (Remaining provinces) N=2320 | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| **Risk category** | | | | | | | | |
| A1:perennial transmission | 4057 | 53.7 | 1587 | 58.4 | 1272 | 50.4 | 1198 | 51.7 |
| A2: periodic transmission | 3509 | 46.3 | 1134 | 41.6 | 1253 | 49.6 | 1122 | 48.3 |
| **Type of net** | | | | | | | | |
| ITN including LLIN | 2721 | 36.0 | 993 | 36.5 | 1089 | 43.1 | 639 | 27.5 |
| Untreated net | 4845 | 64.0 | 1728 | 63.5 | 1436 | 56.9 | 1681 | 72.5 |
| **Net is a LLIN** | | | | | | | | |
| Yes | 1975 | 26.1 | 672 | 24.7 | 783 | 31.0 | 520 | 22.4 |
| No | 5591 | 73.9 | 2049 | 75.3 | 1742 | 69.0 | 1800 | 77.6 |
| **Age of net** | | | | | | | | |
| < 6 months | 713 | 9.4 | 280 | 10.3 | 233 | 9.2 | 200 | 8.6 |
| 6 months to < 1 year | 1456 | 19.2 | 381 | 14.0 | 721 | 28.6 | 354 | 15.3 |
| 1 to < 2 years | 2296 | 30.3 | 754 | 27.7 | 762 | 30.2 | 780 | 33.6 |
| 2 to < 3 years | 1571 | 20.8 | 565 | 20.8 | 412 | 16.3 | 594 | 25.6 |
| 3 years or more | 1263 | 16.7 | 626 | 23.0 | 346 | 13.7 | 291 | 12.5 |
| Other | 151 | 2.0 | 73 | 2.7 | 13 | 0.5 | 65 | 2.8 |
| Not sure | 116 | 1.5 | 42 | 1.5 | 38 | 1.5 | 36 | 1.6 |

| | TOTAL N=7566 | | Domain 1 (Thai-Myanmar border) N=2721 | | Domain 2 (Thai-Cambodia border) N=2525 | | Domain 3 (Remaining provinces) N=2320 | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| **Source of net** | | | | | | | | |
| Govt, VHV | 1848 | 24.4 | 574 | 21.1 | 719 | 28.5 | 555 | 23.9 |
| NGO | 27 | 0.4 | 24 | 0.9 | 1 | 0.0 | 2 | 0.1 |
| Shop / market | 4121 | 54.5 | 1475 | 54.2 | 1094 | 43.3 | 1552 | 66.9 |
| Roaming seller | 1000 | 13.2 | 283 | 10.4 | 577 | 22.8 | 140 | 6.0 |
| Other | 365 | 4.8 | 260 | 9.6 | 71 | 2.8 | 34 | 1.5 |
| Don't know | 205 | 2.7 | 105 | 3.9 | 63 | 2.5 | 37 | 1.6 |
| **Price of net** | | | | | | | | |
| No cost | 2127 | 28.1 | 764 | 28.1 | 789 | 31.3 | 574 | 24.7 |
| 200 or less | 1728 | 22.8 | 621 | 22.8 | 573 | 22.7 | 534 | 23.0 |
| ➢ 200 to 300 | 1754 | 23.2 | 584 | 21.5 | 596 | 23.6 | 574 | 24.7 |
| 300 + | 1858 | 24.6 | 711 | 26.1 | 540 | 21.4 | 607 | 26.2 |
| Don't know | 99 | 1.3 | 41 | 1.5 | 27 | 1.1 | 31 | 1.3 |
| **Size of net** | | | | | | | | |
| Single size / hammock | 259 | 3.4 | 107 | 3.9 | 90 | 3.6 | 62 | 2.7 |
| For 2 people | 3544 | 46.8 | 1142 | 42.0 | 1227 | 48.6 | 1175 | 50.6 |
| For more than 2 people | 3380 | 44.7 | 1351 | 49.7 | 1123 | 44.5 | 906 | 39.0 |
| Don't know | 383 | 5.1 | 121 | 4.5 | 85 | 3.4 | 177 | 7.6 |
| **Net colour** | | | | | | | | |
| White | 4468 | 59.1 | 1773 | 65.2 | 1296 | 51.3 | 1399 | 60.3 |
| Green | 547 | 7.2 | 139 | 5.1 | 297 | 11.8 | 111 | 4.8 |
| Blue | 1102 | 14.6 | 335 | 12.3 | 401 | 15.9 | 366 | 15.8 |
| Multicolour | 180 | 2.4 | 56 | 2.1 | 40 | 1.6 | 84 | 3.6 |
| Other | 1197 | 15.8 | 406 | 14.9 | 464 | 18.4 | 327 | 14.1 |
| Don't know | 72 | 1.0 | 12 | 0.4 | 27 | 1.1 | 33 | 1.4 |
| **Net has any hole** | | | | | | | | |
| No | 6152 | 81.3 | 2101 | 77.2 | 2137 | 84.6 | 1914 | 82.5 |
| Yes | 1216 | 16.1 | 586 | 21.5 | 323 | 12.8 | 307 | 13.2 |
| Don't know | 198 | 2.6 | 34 | 1.2 | 65 | 2.6 | 99 | 4.3 |
| **Frequency washed** | | | | | | | | |
| Never | 1498 | 19.8 | 576 | 21.2 | 436 | 17.3 | 486 | 20.9 |
| Weekly | 641 | 8.5 | 204 | 7.5 | 374 | 14.8 | 63 | 2.7 |
| Monthly | 2067 | 27.3 | 768 | 28.2 | 897 | 35.5 | 402 | 17.3 |
| Every 2-3 months | 1835 | 24.2 | 534 | 19.6 | 548 | 21.7 | 753 | 32.5 |
| Twice per year | 821 | 10.9 | 326 | 12.0 | 102 | 4.0 | 393 | 16.9 |
| Once a year | 447 | 5.9 | 230 | 8.4 | 135 | 5.3 | 82 | 3.5 |
| < once a year | 64 | 0.8 | 26 | 1.0 | 12 | 0.5 | 26 | 1.1 |
| Not sure | 193 | 2.6 | 57 | 2.1 | 21 | 0.8 | 115 | 5.0 |
| **Used last night** | | | | | | | | |
| Yes | 5346 | 70.7 | 1784 | 65.6 | 1875 | 74.3 | 1687 | 72.7 |
| No | 2220 | 29.3 | 937 | 34.4 | 650 | 25.7 | 633 | 27.3 |

More nets were found in households in villages with perennial transmission (53.7 vs. 46.3%); the gap was more marked at the Thai Myanmar border (58.4 vs. 41.6%) while in the other domains, nets

tended to equally present across transmission category. Nearly two third (64.0%) of nets were untreated and only a quarter (26.1%) of all nets were LLIN. This proportion was higher at the Thai Cambodia border (31.0%). Out of all nets, 58.9% were acquired less than 2 years ago; at the Thai Cambodia border, household nets were more recent with 68.0% less than 2 years old, compared to 52% at the Thai Myanmar border and 57.5% in Domain 3. More than half (54.5%) of the nets were bought in a shop or the local market and 24.4% were distributed by the government or the village health volunteer. At the Thai Cambodia border, there were more nets obtained through government distribution (28.5%) and fewer nets bought in the shop or the market (43.3%). In Domain 3, this pattern was reversed with more nets bought in a shop (66.9%) and less nets obtained through government distribution (23.9%). It is also worth noting that roaming sellers were more common at the Thai Myanmar border (10.4%) and Thai Cambodia border (22.85) as opposed to Domain 3 (6.0%). In the same way, more nets were acquired freely at the Thai Cambodia border (31.3%) as opposed to Thai Myanmar border (28.1%) and Domain 3 (24.7%). These observations strongly suggest that there were recent efforts to distribute nets, concentrated at the Thai Cambodia border. The majority of net size were for 2 people (46.8%) or for more than 2 people (44.7%) and 59.1% of nets were white. Out of all nets, 16.1% were reported to have any hole on the survey day and this proportion was higher at the Thai Myanmar border (21.5%) and lower at the Thai Cambodia border (12.8%), which is coherent with nets being more recent in the Thai Cambodia border area. Also, at the Thai Cambodia border, nets were more likely to be washed regularly with 72% of nets washed between every week and every three months as opposed to 55.3% at the Thai Myanmar border and 52.5% in Domain 3. Again, this suggests that householders take better care for their nets in these villages, and this might be due to the BCC efforts in this area. Lastly, 70.7% of all nets found in households were used the previous night.

Table 3.3.7 presents personal use of mosquito nets the previous night of the interview, by background characteristic. Several factors were found to be determinants for net use. People living at the Thai Cambodia border were more likely to use a net of any type compared to individuals in Domain 3 (86.4% vs 76.1%, p=0.02) and this was also true for ITN (37.4 vs. 20.3%; p=0.02) and for LLIN although this difference was not statistically significant (23.7 vs. 15.6%; p=0.22). Poorest people were likely to use an ITN and a LLIN compared to other wealth quintiles ($p<0.001$ for both net categories); net use appeared to decrease with wealth and was the lowest amongst the fourth quintile. Unsurprisingly, net use was significantly higher in households owning at least 1 net for every 2 people (39.9 vs. 24.6% for ITN; $p<0.01$ and 32.1 vs. 15.2% for LLIN; $p<0.001$). However, it is worrying that net use in these households was still far below the 80% target, even if people had theoretically enough nets for universal access. It was also interesting that temporary visitors were significantly less likely to use a net of any type (80.2 vs. 52.7%; $p<0.001$) but this was not the case considering LLIN (18.8 vs. 19.3%). This could be due to householders preferring using untreated nets and give LLIN to visitors.

**Table 3.3.7 Summary of mosquito net usage (previous night) by background characteristic**

| Background characteristic | Denomi-nator | People using a net the previous night | | | People using an ITN the previous night | | | People using a LLIN the previous night | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % (95%CI) | P-value | n | % (95%CI) | P-value | n | % (95%CI) | P-value |
| **Overall** | 10,386 | 8300 | 79.9 (76.6 to 82.8) | | 2978 | 28.7 (24.2 to 33.6) | | 1958 | 18.9 (15.4 to 22.9) | |
| **Domain** | | | | | | | | | | |
| Thai – Myanmar border | 3756 | 2937 | 78.2 (71.3 to 83.9) | **0.02** | 1107 | 29.5 (21.1 to 39.5) | **0.02** | 673 | 17.9 (11.4 to 27.1) | 0.22 |
| Thai- Cambodia border | 3083 | 2664 | 86.4 (83.0 to 89.2) | | 1152 | 37.4 (29.4 to 46.1) | | 732 | 23.7 (18.4 to 30.0) | |
| Remaining provinces | 3547 | 2699 | 76.1 (69.9 to 81.3) | | 719 | 20.3 (14.2 to 28.1) | | 553 | 15.6 (11.0 to 21.7) | |
| **Malaria transmission** | | | | | | | | | | |
| A1 (perennial) | 5355 | 4377 | 81.7 (77.8 to 85.1) | 0.23 | 1577 | 29.4 (24.1 to 35.4) | 0.74 | 1130 | 21.1 (16.4 to 26.8) | 0.23 |
| A2 (periodic) | 5031 | 3923 | 78.0 (72.4 to 82.7) | | 1401 | 27.8 (20.8 to 36.2) | | 828 | 16.5 (11.7 to 22.6) | |
| **Wealth quintile** | | | | | | | | | | |
| Poorest | 2562 | 2124 | 82.9 (74.2 to 89.1) | 0.37 | 1104 | 43.1 (33.2 to 53.6) | **<0.001** | 748 | 29.2 (21.1 to 38.9) | **<0.001** |
| Poorer | 2106 | 1729 | 82.1 (75.7 to 87.1) | | 607 | 28.8 (20.1 to 39.4) | | 373 | 17.7 (12.1 to 25.2) | |
| Middle | 2259 | 1782 | 78.9 (73.3 to 83.6) | | 555 | 24.6 (18.8 to 31.4) | | 378 | 16.7 (11.9 to 23.0) | |
| Richer | 1649 | 1239 | 75.1 (69.8 to 79.8) | | 246 | 14.9 (10.4 to 20.9) | | 160 | 9.7 (6.1 to 15.1) | |
| Richest | 1810 | 1426 | 78.8 (73.0 to 83.6) | | 466 | 25.7 (20.8 to 31.4) | | 299 | 16.5 (12.4 to 21.6) | |
| **Age groups** | | | | | | | | | | |
| Less than 5 years | 680 | 567 | 83.4 (78.8 to 87.1) | 0.05 | 221 | 32.5 (26.3 to 39.4) | 0.03 | 147 | 21.6 (17.0 to 27.1) | 0.11 |
| 5 to 14 years | 1617 | 1252 | 77.4 (71.8 to 82.2) | | 506 | 31.3 (25.1 to 38.2) | | 329 | 20.4 (15.2 to 26.6) | |
| 15 years or more | 7991 | 6396 | 80.0 (76.9 to 82.8) | | 2221 | 27.8 (23.6 to 32.5) | | 1458 | 18.2 (15.0 to 22.0) | |
| Missing | 98 | 85 | 86.8 (76.7 to 92.9) | | 30 | 30.6 (21.4 to 41.7) | | 24 | 24.5 (15.6 to 36.3) | |
| **Sex** | | | | | | | | | | |
| Male | 4944 | 3920 | 79.3 (75.9 to 82.3) | 0.34 | 1377 | 27.9 (23.5 to 32.7) | 0.11 | 891 | 18.0 (14.6 to 22.0) | **0.01** |
| Female | 5186 | 4184 | 80.7 (77.3 to 83.6) | | 1507 | 29.1 (24.3 to 34.3) | | 994 | 19.2 (15.6 to 23.4) | |
| Missing | 256 | 196 | 76.6 (63.5 to 86.0) | | 94 | 36.7 (25.6 to 49.4) | | 73 | 28.5 (19.6 to 39.6) | |
| **Nationality*** | | | | | | | | | | |
| Thai | 9898 | 7919 | 80.0 (76.7 to 82.9) | 0.76 | 2867 | 29.0 (24.4 to 34.0) | 0.48 | 1879 | 19.0 (15.5 to 23.1) | 0.71 |
| M1 migrants | 297 | 225 | 75.8 (61.6 to 85.9) | | 67 | 22.5 (10.7 to 41.5) | | 43 | 14.5 (5.9 to 31.2) | |
| M2 migrants | 68 | 52 | 76.5 (39.4 to 94.2) | | 13 | 19.1 (9.8 to 33.9) | | 12 | 17.7 (9.4 to 30.7) | |
| Missing | 123 | 104 | 84.5 (66.6 to 93.8) | | 31 | 25.2 (14.6 to 39.9) | | 24 | 19.5 (10.4 to 33.6) | |
| **Forest goers**** | | | | | | | | | | |
| Yes | 1356 | 1069 | 78.8 (74.4 to 82.7) | 0.51 | 353 | 26.0 (20.0 to 33.2) | 0.31 | 234 | 17.3 (13.1 to 22.4) | 0.37 |
| No | 9030 | 7231 | 80.1 (76.7 to 83.1) | | 2625 | 29.1 (24.5 to 34.1) | | 1724 | 19.1 (15.5 to 23.3) | |

| Background characteristic | Denomi-nator | People using a net the previous night | | | People using an ITN the previous night | | | People using a LLIN the previous night | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % (95%CI) | P-value | n | % (95%CI) | P-value | n | % (95%CI) | P-value |
| **Travellers*** ** | | | | | | | | | | |
| Yes | 666 | 528 | 79.3 (73.9 to 83.8) | 0.75 | 169 | 25.4 (18.6 to 33.5) | 0.23 | 99 | 14.9 (10.6 to 20.5) | 0.04 |
| No | 9720 | 7772 | 80.0 (76.6 to 82.9) | | 2809 | 28.9 (24.4 to 33.8) | | 1859 | 19.1 (15.6 to 23.2) | |
| **Visitors**** ** | | | | | | | | | | |
| Yes | 114 | 60 | 52.7 (37.4 to 67.5) | **<0.001** | 23 | 20.2 (11.4 to 33.2) | 0.19 | 22 | 19.3 (10.7 to 32.4) | 0.93 |
| No | 10272 | 8240 | 80.2 (76.9 to 83.2) | | 2955 | 28.8 (24.2 to 33.8) | | 1936 | 18.8 (15.4 to 22.9) | |
| **Reported fever cases the past 2 weeks** | | | | | | | | | | |
| Yes | 446 | 368 | 82.5 (76.6 to 87.2) | 0.27 | 146 | 32.7 (26.0 to 40.2) | 0.11 | 102 | 22.9 (17.0 to 30.1) | 0.08 |
| No | 9940 | 7932 | 79.8 (76.5 to 82.7) | | 2832 | 28.5 (24.0 to 33.5) | | 1856 | 18.7 (15.2 to 22.7) | |
| **People living in household with 1 net/ITN/LLIN for 2 people** | | | | <0.01 | | | **<0.01** | | | **<0.001** |
| Yes | | 7137/8762 | 81.5 (78.3 to 84.3) | | 1103/2769 | 39.9 (32.9 to 47.2) | | 716/2232 | 32.1 (25.9 to 39.0) | |
| No | | 1163/1624 | 71.6 (63.1 to 78.8) | | 1875/7617 | 24.6 (19.9 to 30.0) | | 1242/8154 | 15.2 (12.0 to 19.1) | |
| **Household received any information on malaria in previous 6 months** | | | | | | | | | | |
| Yes | 4131 | 3418 | 82.7 (78.2 to 86.5) | 0.08 | 1194 | 28.9 (23.3 to 35.2) | 0.94 | 720 | 17.4 (13.4 to 22.4) | 0.41 |
| No | 6255 | 4883 | 78.1 (74.1 to 81.6) | | 1789 | 28.6 (22.8 to 35.2) | | 1244 | 19.9 (15.4 to 25.3) | |

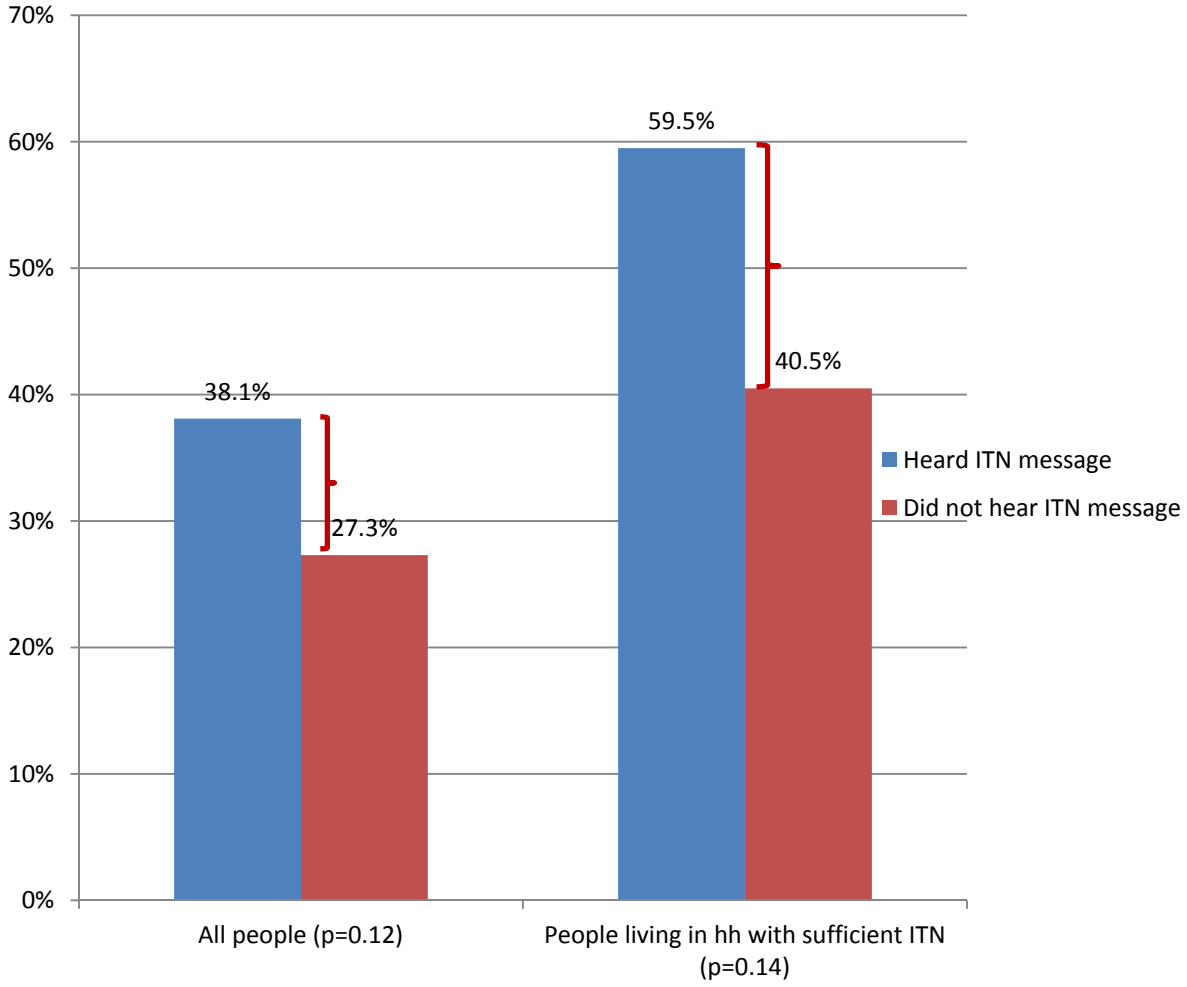
*M1= migrants arrived less than 6 months ago; M2= migrants arrived more than 6 months ago

**Forest goers= people who sometimes go to the forest, plantation or garden and stay overnight

***Travellers= people whi have travelled and stayed overnight somewhere else during the previous 6 months

****Temporary visitors= people who are found in the house (guests, friends, relatives) on the survey day and who was staying for less than 6 months since the survey day

**Figure 3.3.7 Impact of BCC messaging on ITN use the previous night (N=10,834)**




ITN use the previous night was assessed in relation to the household coverage of the BCC message about ITN use. It revealed that people living in a household where the respondent heard the BCC message about ITN use were more likely to use an ITN the previous night (38.1 versus 27.3%). Also, excluding people living in households with insufficient ITN, this difference was even higher although not statistically significant (59.5 versus 40.5%). This tells us that effective BCC efforts impact on people's behaviour regarding ITN use, providing that ITN are available in households.

**Table 3.3.8 Factors of association of net use in the forest (N=1,501)**

| Factors of association | OR | 95%CI | P value |
|---|---|---|---|
| **UNIVARIATE ANALYSIS: net use last time in forest** | | | |
| Lives in Domain 3 vs. lives in border area | 0.22 | 0.07 to 0.66 | <0.01 |
| Hh know ITN as prevention method | 5.18 | 2.18 to 12.32 | <0.001 |
| Lives in a hh where respondent feels at risk of malaria | 0.54 | 0.30 to 0.96 | 0.04 |
| Lives in a hh that got any free net from distribution | 1.32 | 0.69 to 2.54 | 0.39 |
| Used a ITN last night vs did not use last night | 1.99 | 1.10 to 3.60 | 0.02 |
| Lives in a hh in the 2 poorest quintiles | 2.34 | 1.26 to 4.34 | <0.01 |
| Lives in a hh with at least 1 ITN | 2.64 | 1.20 to 5.79 | <0.05 |
| Lives in a hh with 1 ITN for every 2 people | 2.29 | 1.26 to 4.17 | <0.01 |
| Lives in a hh remembering the ITN BCC message | 2.48 | 1.11 to 5.54 | <0.05 |
| **LOGISTIC REGRESSION MODELLING** | | | |
| Does BCC increase net use last time in the forest? *(Adjusted OR)* | | | |
| Hh heard message about ITN use | 2.51 | 1.09 to 5.79 | 0.03 |
| Lives in domain 3 | 0.22 | 0.08 to 0.61 | <0.005 |
| Hh owns 1 ITN for 2 people | 1.57 | 0.88 to 2.78 | 0.12 |

Table 3.1.5 present determinant of net use among forest goers the last time they were in the forest. This analysis revealed that forest goers living in Domain 3 (remaining provinces) were significantly less likely to use a net last time in the forest and this association was not confounded by any other variable of investigation. On the other hand, it was not surprising that availability of ITN in the house was significantly associated with ITN use in the forest. Therefore, forest goers living in households where the respondent heard the message about ITN use were 2.51 times more likely to use a net last time in the forest, accounting for the effect of domain and net coverage (1 ITN for every 2 people).

**Table 3.3.9 Factors of association of type of net used last time in the forest (N=209)**

| Factors of association | OR | 95%CI | P value |
|---|---|---|---|
| **UNIVARIATE ANALYSIS: used an ITN last time in forest** | | | |
| Hh heard message about ITN use | 5.49 | 1.66 to 18.17 | <0.01 |
| Lives in hh knowing ITN as prevention method | 6.60 | 2.21 to 19.70 | 0.001 |
| Lives in hh that got any free net from distribution | 2.96 | 0.82 to 10.70 | 0.10 |
| Lives in a hh where respondent feels at risk of malaria | 2.40 | 0.80 to 7.20 | 0.11 |
| Lives in hh knowing malaria transmission mode | 1.78 | 0.59 to 5.38 | 0.30 |
| Lives in Domain 3 vs. lives in border area | 2.42 | 0.43 to 13.57 | 0.31 |
| Lives in a hh in the 2 poorest quintiles | 0.67 | 0.20 to 2.19 | 0.50 |
| Used a ITN last night vs did not use last night | 2.54 | 0.85 to 7.57 | 0.09 |
| Lives in a hh with at least 1 ITN | 7.62 | 1.25 to 46.56 | 0.03 |
| Lives in a hh with 1 ITN for every 2 people | 4.39 | 1.24 to 15.52 | 0.02 |
| **LOGISTIC REGRESSION MODELLING** | | | |
| Is BCC associated with ITN used vs untreated net in forest? *(Adjusted OR)* | | | |
| Hh heard message about ITN use | 3.58 | 1.09 to 11.77 | 0.04 |
| Hh owns 1 ITN for 2 people | 4.24 | 1.32 to 13.59 | 0.02 |
| Lives in domain 3 | 1.86 | 0.39 to 8.77 | 0.43 |
| Used an ITN in house last night | 0.72 | 0.30 to 1.75 | 0.46 |

Forest goers living in households that heard the BCC message about ITN use were 3.58 times more likely to use an ITN net last time in the forest as opposed to an untreated net. Unsurprisingly, the factor most associated with ITN use was ownership of enough ITN (1 for every 2 people). This shows that BCC messaging targeting households positively influence the behaviour of people working in the forest in Thailand, providing that ITN are available in sufficient quantity.

**Figure 3.3.8 Reasons for not using nets the previous night among household with any net and where some member did not use a net (N=444)**

*Multiple answers possible*

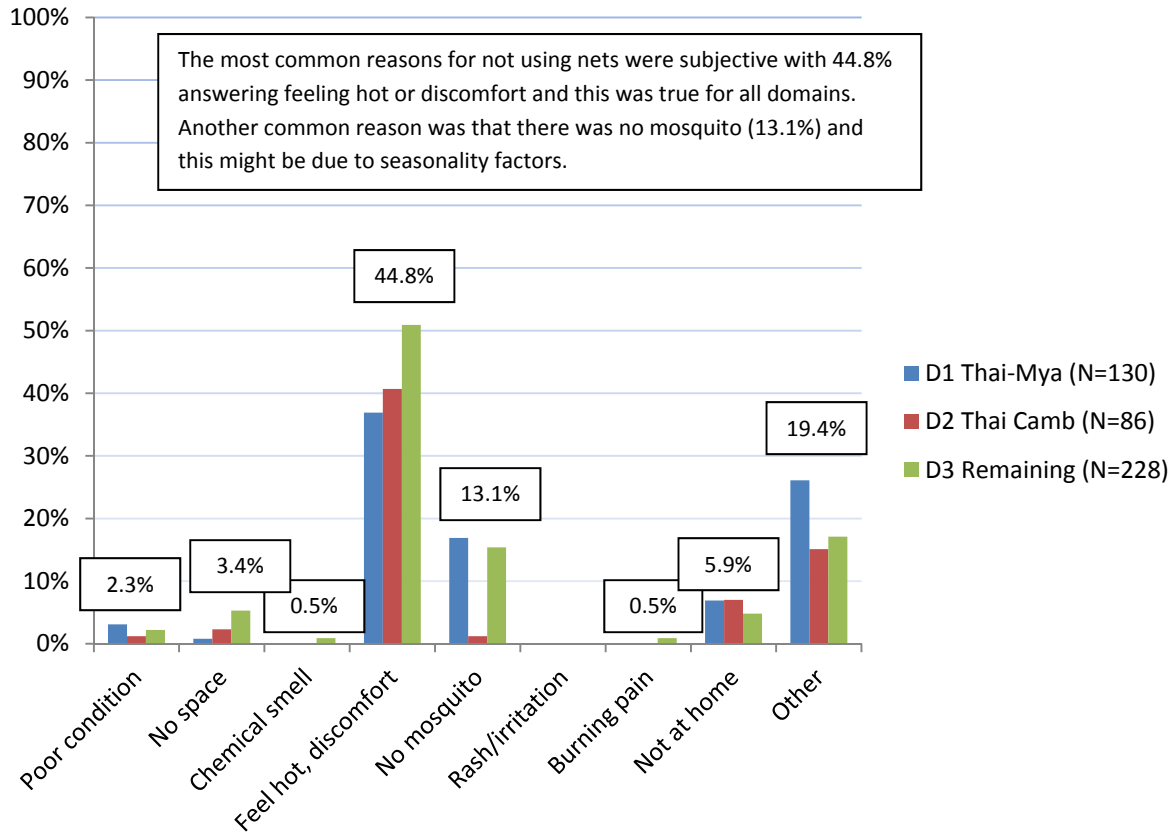


**Figure 3.3.9 Alternative use of household nets among households that have any net that they are not using for sleeping (N=1254)**

*Multiple answers possible*

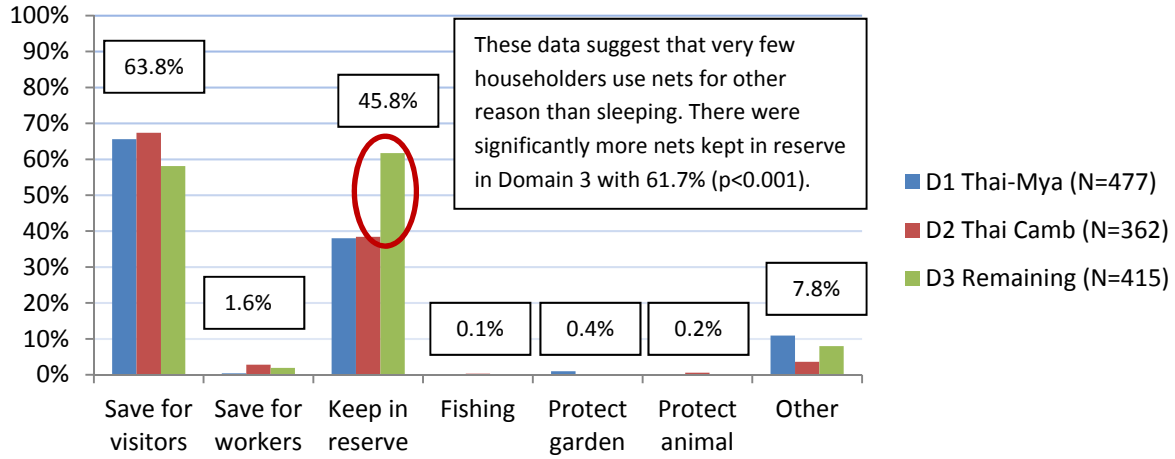



**Figure 3.3.10 Place to buy a new net by domain (N=3300)**

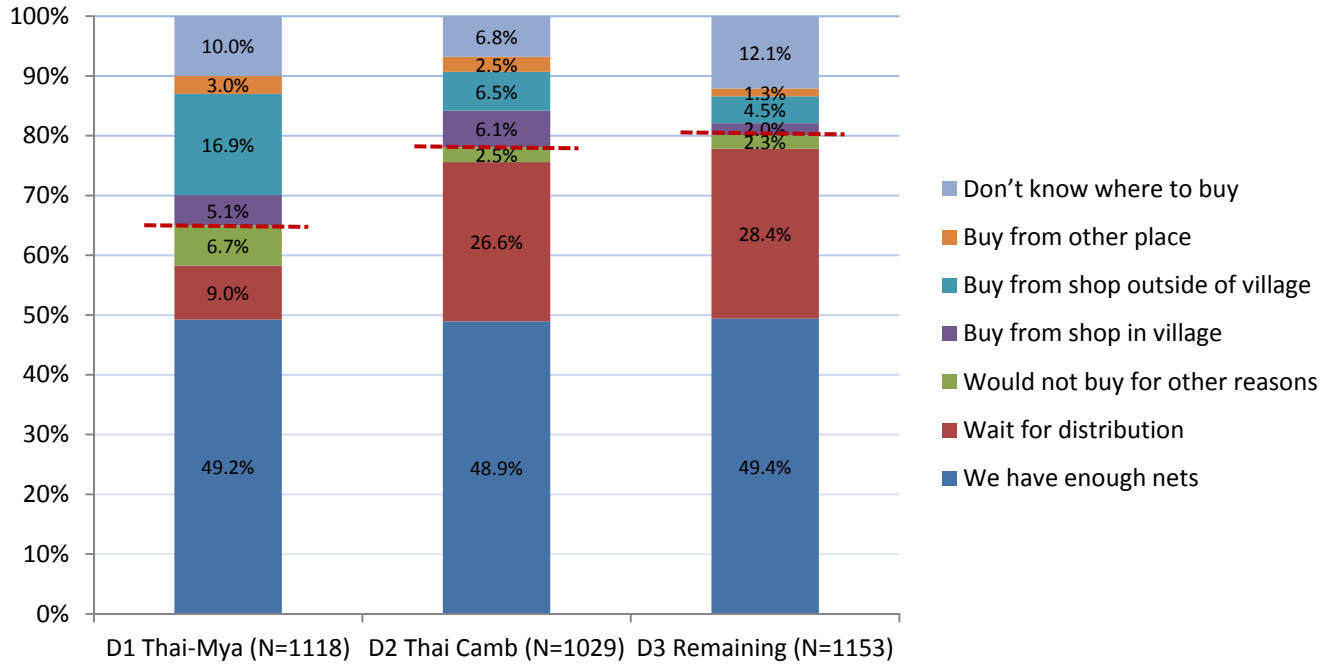


**Figure 3.3.11 Place to buy a new net by socio economic level (N=3300)**

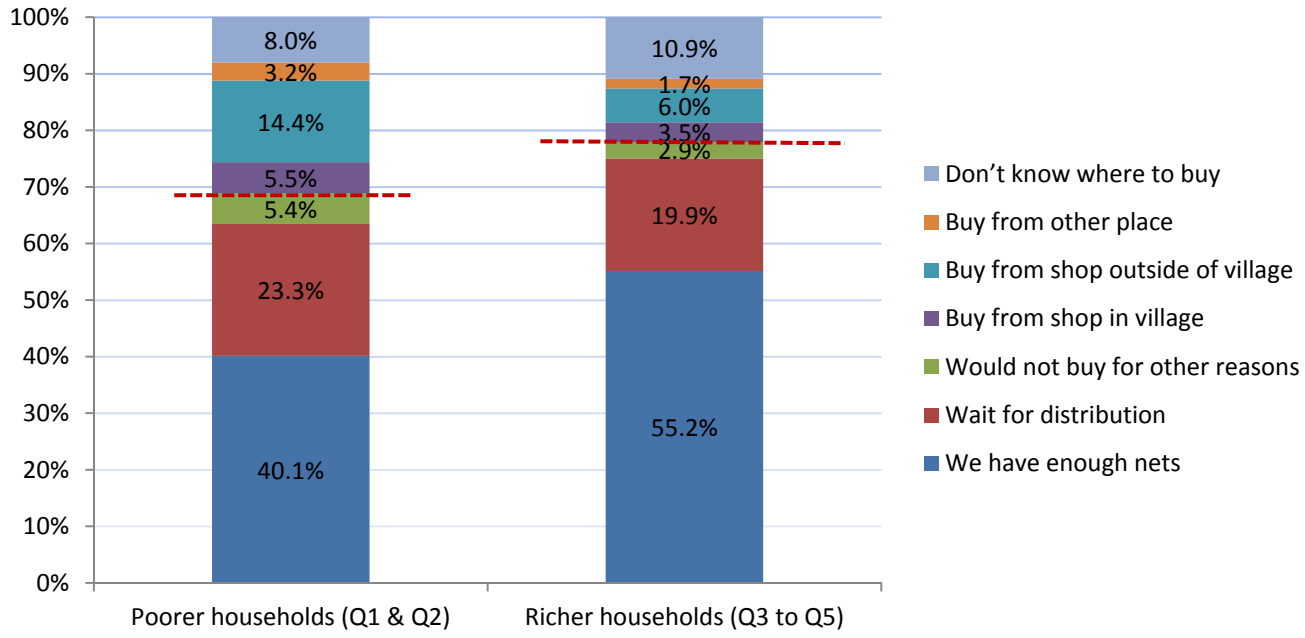
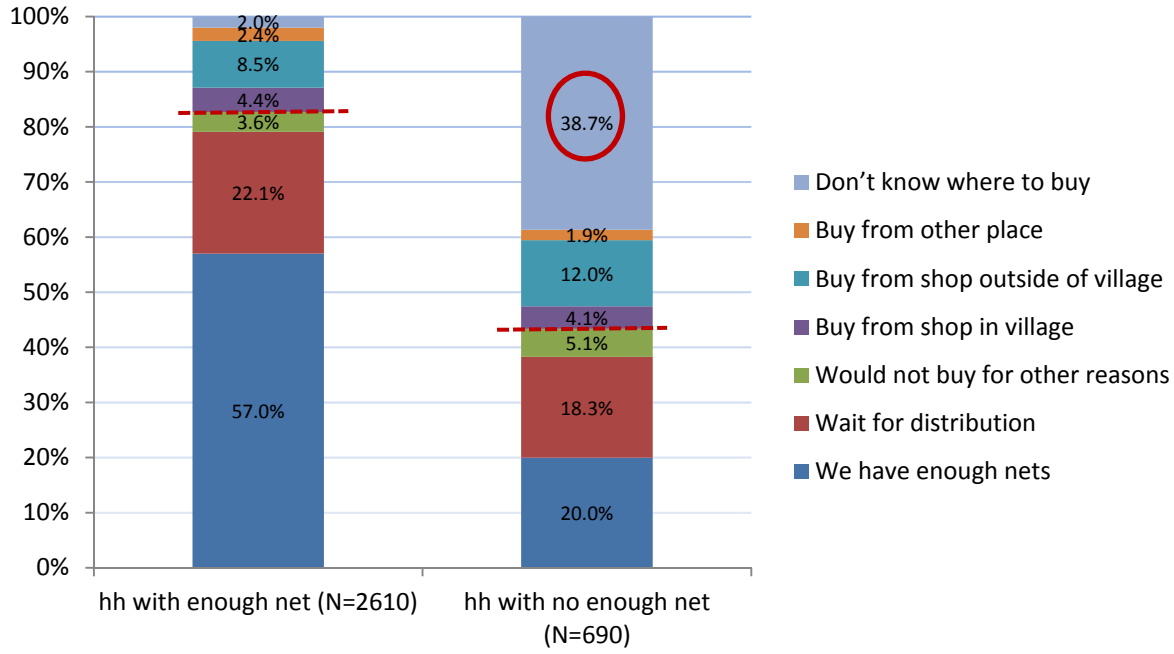



**Figure 3.3.12 Place to buy a new net in relation to net ownership (N=3300)**




When asked where to go to buy a new net, the majority of households (74.4%) replied they would not buy a net because either they already have enough nets or they would wait for a distribution or for other reasons. This proportion was lower at the Thai Myanmar border with 65.7%. Overall, 9.7% don't know where to buy a net.

The same analysis was performed, stratifying by richer or poorer categories to assess whether the above results were confounded by wealth (Figure 3.3.10). It tells us that poorer households would

be more likely to buy a new net as opposed to richer households (31.1 vs. 22.1%). However, richer households considered they had enough nets more often (55.2 vs. 40.1%). This suggests that the cost of buying a new net is not preventing people from buying new nets to a great extent.

Finally, when stratifying by net ownership (Figure 3.3.11), it appeared that what would most determine whether a household would buy a new net was the insufficient quantity of net owned to ensure universal access of household members (1 net for every 2 people). It also shows that even if these households would be more likely to buy a new net, 38.7% would not know where to go and 20% considered that had enough net even if the ratio of net per people was less than 1/2.

## 3.4 MALARIA TREATMENT

**Table 3.4.1 Respondents' access to health care in case of reported fever in previous 2 weeks**

| FEVER PAST 2 WEEKS | TOTAL | | Domain 1 (Thai-Myanmar border) | | Domain 2 (Thai-Cambodia border) | | Domain 3 (Remaining provinces) | |
|---|---|---|---|---|---|---|---|---|
| | % (N) | 95% CI | % (N) | 95% CI | % (N) | 95% CI | % (N) | 95% CI |
| Had fever in past 2 weeks (N=10833) | 4.2 (456) | 3.5 to 5.0 | 5.3 (208) | 4.1 to 6.8 | 3.6 (118) | 2.7 to 4.8 | 3.6 (130) | 2.4 to 5.2 |
| **Seek treatment for fever (N= 456)** | | | | | | | | |
| Yes | 77.4 (353) | 71.4 to 82.5 | 67.8 (141) | 58.2 to 76.1 | 78.0 (92) | 66.0 to 86.6 | 92.3 (120) | 86.3 to 95.8 |
| No | 22.6 (103) | 17.5 to 28.6 | 32.2 (67) | 23.9 to 41.8 | 22.0 (26) | 13.4 to 34.0 | 7.7 (10) | 4.2 to 13.7 |
| **Delivery channel for the first source of health care for fever (N=353)** | | | | | | | | |
| Health staff at community level | 6.0 (21) | 2.6 to 12.9 | 9.2 (13) | 2.8 to 26.6 | 2.2 (2) | 0.5 to 9.1 | 5.0 (6) | 2.0 to 12.1 |
| Public HF | 66.0 (233) | 58.1 to 73.1 | 69.5 (98) | 55.0 to 81.0 | 63.0 (58) | 49.4 to 74.9 | 64.2 (77) | 50.6 to 75.8 |
| Drug store | 2.8 (10) | 1.1 to 7.3 | 1.4 (2) | 0.3 to 5.6 | 0 (-) | - | 6.7 (8) | 1.9 to 20.5 |
| Private facility | 19.8 (70) | 14.4 to 26.7 | 14.2 (20) | 6.8 to 27.2 | 23.9 (22) | 13.1 to 39.6 | 23.3 (28) | 15.5 to 33.6 |
| Other | 3.1 (11) | 1.2 to 7.8 | 1.4 (2) | 0.4 to 5.0 | 9.8 (9) | 3.1 to 26.6 | 0.0 (-) | - |
| Don't know | 2.3 (8) | 1.0 to 4.9 | 4.3 (6) | 1.7 to 10.4 | 1.1 (1) | 0.2 to 7.3 | 0.8 (1) | 0.1 to 5.8 |
| **Sought health care within 24 hours (N=353)** | | | | | | | | |
| Yes | 42.2 (149) | 35.7 to 49.0 | 30.5 (43) | 22.0 to 40.6 | 43.5 (40) | 31.5 to 56.3 | 55.0 (66) | 42.1 to 67.3 |
| No | 52.7 (186) | 45.7 to 59.6 | 64.5 (91) | 54.4 to 73.5 | 46.7 (43) | 32.6 to 61.4 | 43.3 (52) | 31.6 to 55.9 |
| Don't know | 5.1 (18) | 2.6 to 9.9 | 5.0 (7) | 1.8 to 13.1 | 9.8 (9) | 3.2 to 26.0 | 1.7 (2) | 0.5 to 5.8 |
| **Sought health care within 48 hours (N=353)** | | | | | | | | |
| Yes | 73.4 (259) | 68.0 to 78.1 | 65.2 (92) | 57.0 to 72.7 | 76.1 (70) | 63.8 to 85.2 | 80.8 (97) | 72.2 to 87.3 3 |
| No | 21.5 (76) | 17.4 to 26.4 | 29.8 (42) | 22.9 to 37.7 | 14.1 (13) | 7.7 to 24.5 | 17.5 (21) | 11.7 to 25.3 |
| Don't know | 5.1 (18) | 2.6 to 9.9 | 5.0 (7) | 1.8 to 13.1 | 9.8 (9) | 3.2 to 26.0 | 1.7 (2) | 0.5 to 5.8 |
| **Had a malaria diagnostic test (N=353)** | | | | | | | | |
| Yes | 15.9 (56) | 11.7 to 21.2 | 18.4 (26) | 11.4 to 28.4 | 14.1 (13) | 8.0 to 23.7 | 14.2 (17) | 8.2 to 23.4 |
| No | 79.0 (279) | 72.7 to 84.2 | 75.2 (106) | 63.0 to 84.3 | 79.3 (73) | 68.3 to 87.3 | 83.3 (100) | 73.4 to 90.1 |
| Not sure | 5.1 (18) | 2.7 to 9.5 | 6.4 (9) | 2.7 to 14.6 | 6.5 (6) | 2.0 to 18.9 | 2.5 (3) | 0.6 to 10.4 |
| **Did fever go away after first care provider (N=456)** | | | | | | | | |
| Yes | 14.0 (64) | 10.1 to 19.2 | 16.3 (34) | 9.5 to 26.7 | 12.7 (15) | 7.3 to 21.2 | 11.5 (15) | 7.8 to 16.7 |
| No | 61.8 (282) | 54.9 to 68.3 | 50.5 (105) | 39.8 to 61.1 | 64.4 (76) | 50.9 to 76.0 | 77.7 (101) | 67.0 to 85.6 |
| Don't know | 24.1 (110) | 18.7 to 30.5 | 33.2 (69) | 23.9 to 44.0 | 22.9 (27) | 13.7 to 35.7 | 10.8 (14) | 5.6 to 19.7 |

A total of 456 people (4.2%) reported an episode of fever in the previous 2 weeks and this proportion was slightly higher amongst Thai Myanmar householders (5.3%). Among these reported fever cases, more than three quarter (77.4%) sought treatment. This proportion was significantly higher in Domain 3 compared to the Thai Myanmar border (92.3 vs. 67.8%). The 2 major sources of health care were public health facilities (66.0%) and private health facilities (19.8%). It was encouraging to see that drug store was not a popular source for health care with only 10 cases (2.8%) seeking treatment from a drug store; that proportion was higher in Domain 3 with 6.7%. Lastly, it is worth noting that health staff at community level was more popular at the Thai Myanmar border with 9.2 vs overall 6.0%. Looking at time to access the first source of treatment, 42.2% accessed health care within 24 hours and 73.4% within 48 hours. Time to treatment was significantly longer at the Thai Myanmar border with 30.5% accessing care within 24 hours compared to 55.0% in Domain 3. These results probably reflect the difference in health care services availability, with the Thai Myanmar border area being more remote with less access to health care providers and households in Domain 3 being located in most easily accessible areas. Out of the 353 reported fever cases that sought health care, 15.9% had a test for malaria and surprisingly, this proportion was slightly higher at the Thai Myanmar border with 18.4%. Finally, the fever went away in only 14.0% of cases after seeking treatment from the first source and this proportion was higher at the Thai Myanmar border (16.3%).

**Table 3.4.2 Details of respondents' access to health care in case of reported fever in previous 2 weeks**

| FEVER PAST 2 WEEKS | TOTAL | | Domain 1 (Thai-Myanmar border) | | Domain 2 (Thai-Cambodia border) | | Domain 3 (Remaining provinces) | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| **Type of fever (N=456)** | | | | | | | | |
| Malaria | 5 | 1.1 | 1 | 0.5 | 0 | - | 4 | 3.1 |
| Flu | 301 | 66.0 | 123 | 59.1 | 91 | 77.1 | 87 | 66.9 |
| Tonsillitis | 10 | 2.2 | 3 | 1.4 | 5 | 4.2 | 2 | 1.5 |
| Other | 54 | 11.8 | 32 | 15.4 | 15 | 12.7 | 7 | 5.4 |
| Don't know | 86 | 18.9 | 49 | 23.6 | 7 | 5.9 | 30 | 23.1 |
| **Source of test if had a malaria test (N=56)** | | | | | | | | |
| Malaria clinic | 7/56 | 12.5 | 2/26 | 7.7 | 3/13 | 23.1 | 2/17 | 11.8 |
| MP/BMP | 3/56 | 5.4 | 0/26 | - | 0/14 | - | 3/17 | 17.6 |
| VMV | 1/56 | 1.8 | 1/26 | 3.9 | 0/13 | - | 0/17 | - |
| Public HC | 9/56 | 16.1 | 6/26 | 23.1 | 2/13 | 15.4 | 1/17 | 5.9 |
| Public hospital | 22/56 | 39.3 | 12/26 | 46.2 | 2/13 | 15.4 | 8/17 | 47.1 |
| Private clinic | 3/56 | 5.3 | 1/26 | 3.8 | 1/13 | 7.7 | 1/17 | 5.9 |
| Private hospital | 2/56 | 3.6 | 1/26 | 3.9 | 1/13 | 7.7 | 0/17 | - |
| Don't know | 9/56 | 16.1 | 3/26 | 11.5 | 4/13 | 30.7 | 2/17 | 11.8 |
| **Type of test (if had a malaria test) N=56** | | | | | | | | |
| RDT | 11/56 | 19.7 | 6/26 | 23.1 | 0/13 | - | 5/17 | 29.4 |
| Blood slide | 28/56 | 50.0 | 18/26 | 69.2 | 6/13 | 46.1 | 4/17 | 23.5 |
| Don't know | 17/56 | 30.3 | 2/26 | 7.7 | 7/13 | 53.9 | 8/17 | 47.1 |
| **Test result (N=56)** | | | | | | | | |
| Positive | 4*/56 | 7.1 | 0/26 | - | 0/13 | - | 4/17 | 23.5 |
| Negative | 44/56 | 78.6 | 24/26 | 92.3 | 9/13 | 69.3 | 11/17 | 64.7 |
| Don't know | 8/56 | 14.3 | 2/26 | 7.7 | 4/13 | 30.7 | 2/17 | 11.8 |

| FEVER PAST 2 WEEKS | TOTAL | | Domain 1 (Thai-Myanmar border) | | Domain 2 (Thai-Cambodia border) | | Domain 3 (Remaining provinces) | |
|---|---|---|---|---|---|---|---|---|
| **Source health care from other source (N=456)** | | | | | | | | |
| No | 327 | 71.7 | 132 | 63.4 | 80 | 67.8 | 115 | 88.5 |
| Yes | 25 | 5.5 | 10 | 4.8 | 9 | 7.6 | 6 | 4.6 |
| Go back | 2 | 0.4 | 1 | 0.5 | 0 | - | 1 | 0.8 |
| Don't know | 102 | 22.4 | 65 | 31.3 | 29 | 24.6 | 8 | 6.2 |

***Out of these 4 people, 2 were told the species was P.*f* and the other 2 were not told the species.

The most common type of fever as reported by household respondents was flu (66.0%). It is interesting that at the Thai Myanmar border and in Domain 3, there were respectively 23.6% and 23.1% of respondents that did not know the type of fever as opposed to the Thai Cambodia border where only 5.9% did not know. The three most common sources of malaria tests were the public hospital (39.3%), public health centre (16.1%) and malaria clinic (12.5%). Out of the 56 malaria tests, 50% were using standard microscopy and 19.7% were RDT. At the Thai Cambodia border, 6 out of 7 tests were using microscopy and none was RDT. In total, only 4 out of the 56 tests were positive and 5.5% of the 456 reported fever cases that sought health care went to a second health care providers.

**Figure 3.4.1 Signs and symptoms associated with recent fever episode (N=456)**
*Multiple answers possible*

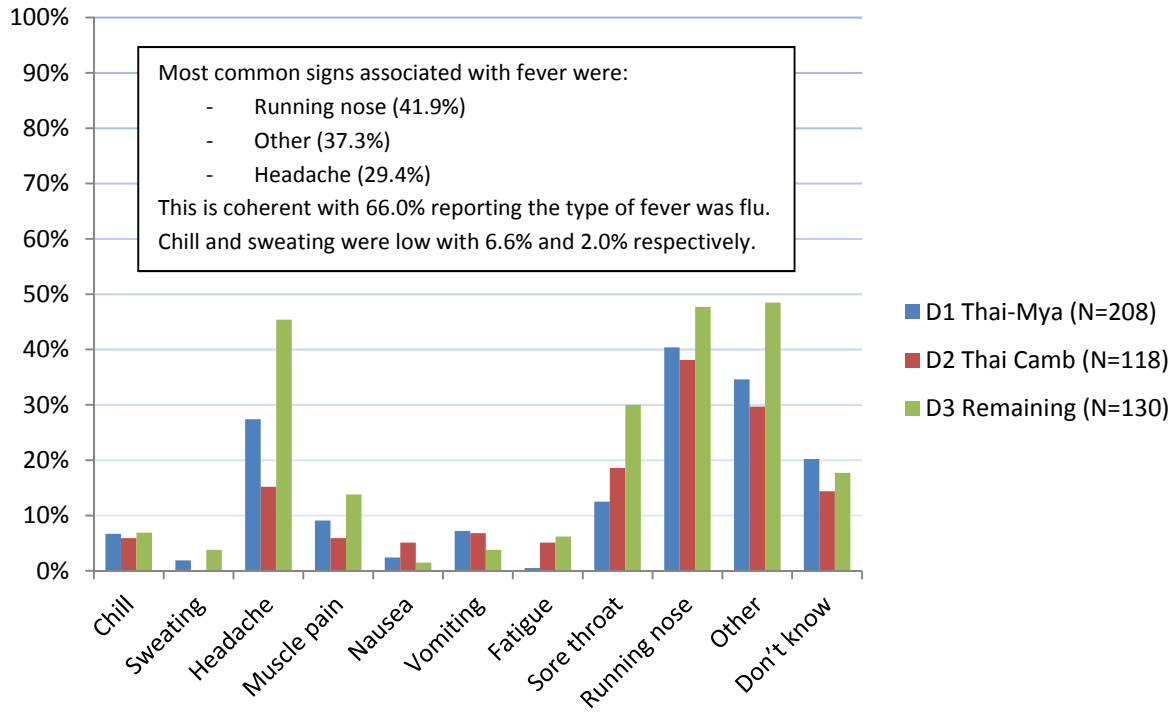
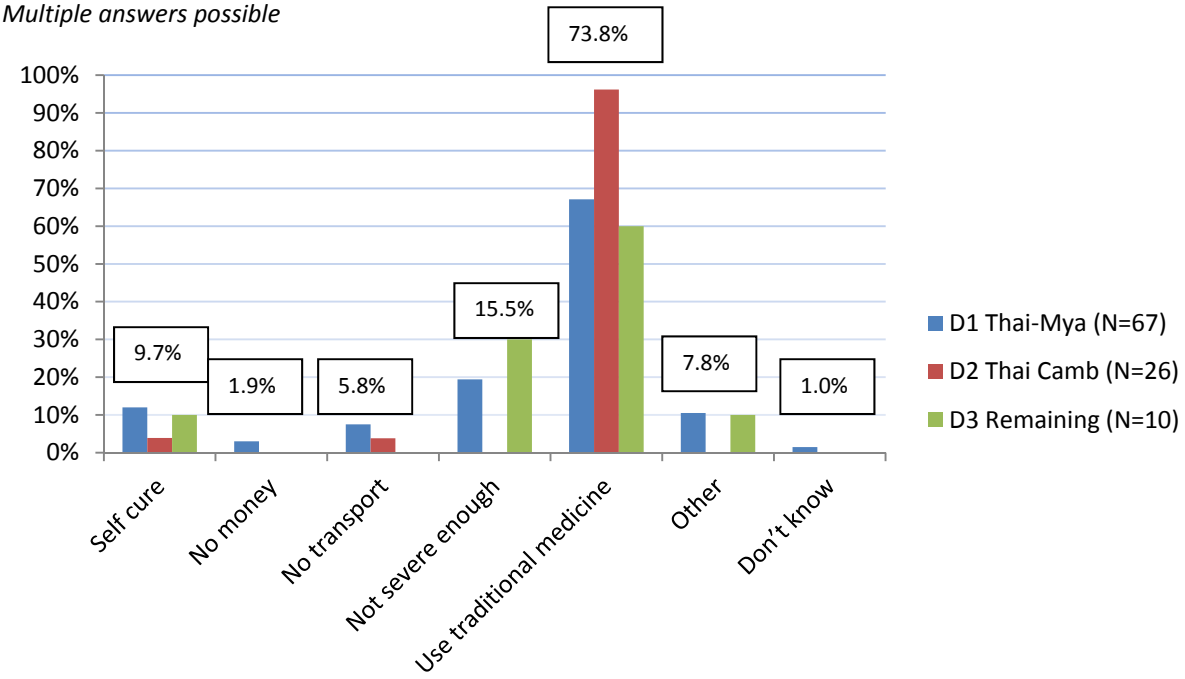


**Figure 3.4.2 Reasons for not seeking treatment (N=103)**

*Multiple answers possible*




Nearly three quarters (73.8%) of reported fever cases that said they did not seek for health care actually did by using traditional medicine. On the other hand, 25.2% decided to treat themselves at home (self-cure) or considered that the symptoms were not severe enough. It is also worth noting that at the Thai Cambodia border nobody thought the fever was not severe enough but a much higher proportion of cases using traditional medicine (96.2%).

**Table 3.4.3 Household respondent knowledge and awareness of malaria**

| | TOTAL N=3300 | | Domain 1 (Thai-Myanmar border) N=1118 | | Domain 2 (Thai-Cambodia border) N=1029 | | Domain 3 (Remaining provinces) N=1153 | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| Mentioned "malaria" as top three reasons for fever | 1275 | 38.7 | 387 | 34.7 | 442 | 43.0 | 446 | 38.7 |
| Ever heard about "malaria" | 2786 | 84.4 | 936 | 83.7 | 822 | 79.9 | 1028 | 89.2 |
| **Amongst those who ever heard about malaria (N=2786)** | | | | | | | | |
| Feels at risk of malaria | 1249 | 44.8 | 311 | 33.2 | 377 | 45.9 | 561 | 54.6 |
| **Can be sure about malaria signs and symptoms by (N=2786)** | | | | | | | | |
| Previous experience | 600 | 21.5 | 119 | 12.7 | 193 | 23.5 | 288 | 28.0 |
| Symptoms | 658 | 23.6 | 165 | 17.6 | 256 | 31.1 | 237 | 23.1 |
| Dr examination | 508 | 18.2 | 163 | 17.4 | 113 | 13.8 | 232 | 22.6 |
| Blood test | 451 | 16.2 | 155 | 16.6 | 119 | 14.5 | 177 | 17.2 |
| Other | 29 | 1.0 | 10 | 1.1 | 7 | 0.9 | 12 | 1.2 |
| Don't know | 540 | 19.4 | 324 | 34.6 | 134 | 16.3 | 82 | 8.0 |
| **Prospect in case of incomplete malaria treatment (N=2786)** | | | | | | | | |
| Nothing | 58 | 2.1 | 16 | 1.7 | 12 | 1.5 | 30 | 2.9 |
| Recurrent illness | 1637 | 58.7 | 463 | 49.5 | 615 | 74.8 | 559 | 54.4 |
| Other | 327 | 11.7 | 112 | 12.0 | 69 | 8.4 | 146 | 14.2 |
| Don't know | 764 | 27.4 | 345 | 36.8 | 126 | 15.3 | 293 | 28.5 |

Overall, 38.7% of all household respondents mentioned “malaria” as one of the top three reasons for fever, 84.4% had heard about malaria and 44.8% felt at risk of malaria. At the Thai Cambodia border, respondents were less likely to have ever heard of malaria (79.9%) but if they did, they were more prone to mention malaria as top three causes for fever (43.0%), suggesting their awareness level was higher than in the other domains. On the other hand, only a third of respondents (33.2%) felt at risk of malaria at the Thai Myanmar border, which is worrying considering population movements across the border and the higher malaria transmission levels in some parts of Eastern Myanmar. Also, only 16.2% would confirm a malaria diagnosis through a blood test, as currently recommended and 19.4% did not know what would happen in case of incompleteness of malaria treatment, meaning that awareness of artemisinin resistance was low. This proportion was even higher at the Thai Myanmar border with 36.8%.

**Figure 3.4.3 Top three diseases mentioned by household respondents for reasons for fever (N=3300)**

*Multiple answers possible.*

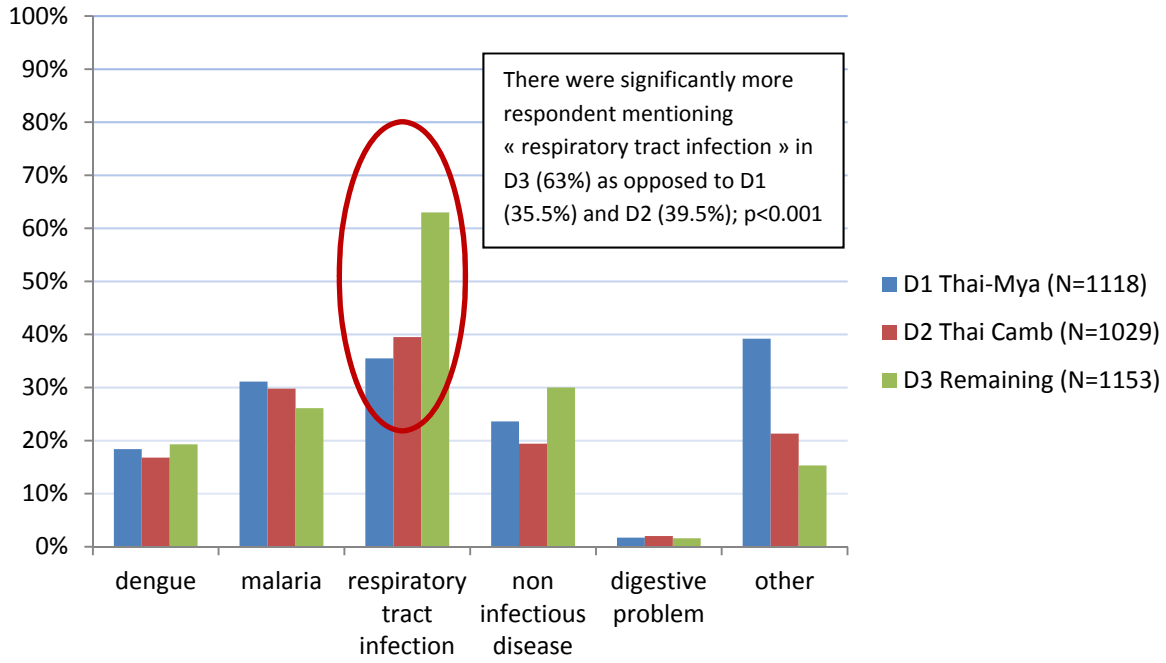
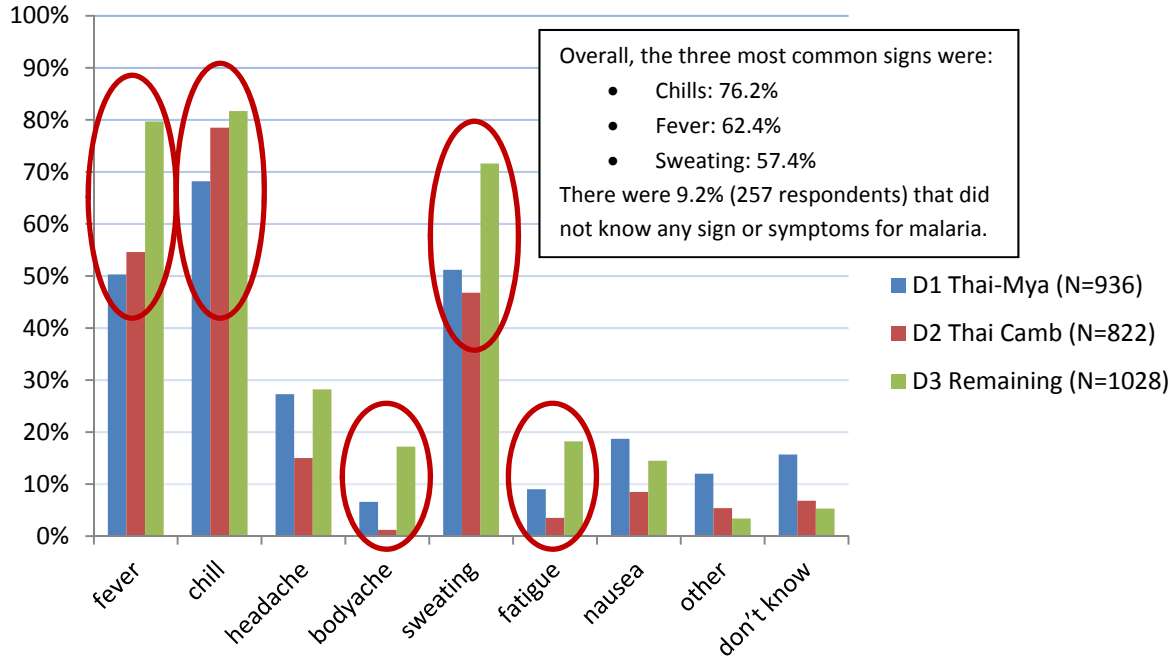


**Figure 3.4.4 Knowledge of signs and symptoms of malaria (N=2786)**

*Multiple answers possible.*




Most common signs and symptoms for malaria (fever, chill, sweating) were significantly more cited in Domain 3, reaching more than 70% for all three signs. Body ache and fatigue were also more likely to be mentioned in Domain 3, showing that knowledge of malaria signs and symptoms was significantly higher in these provinces.

**Figure 3.4.5 Knowledge of signs and symptoms of severe malaria (N=2786)**

*Multiple answers possible.*

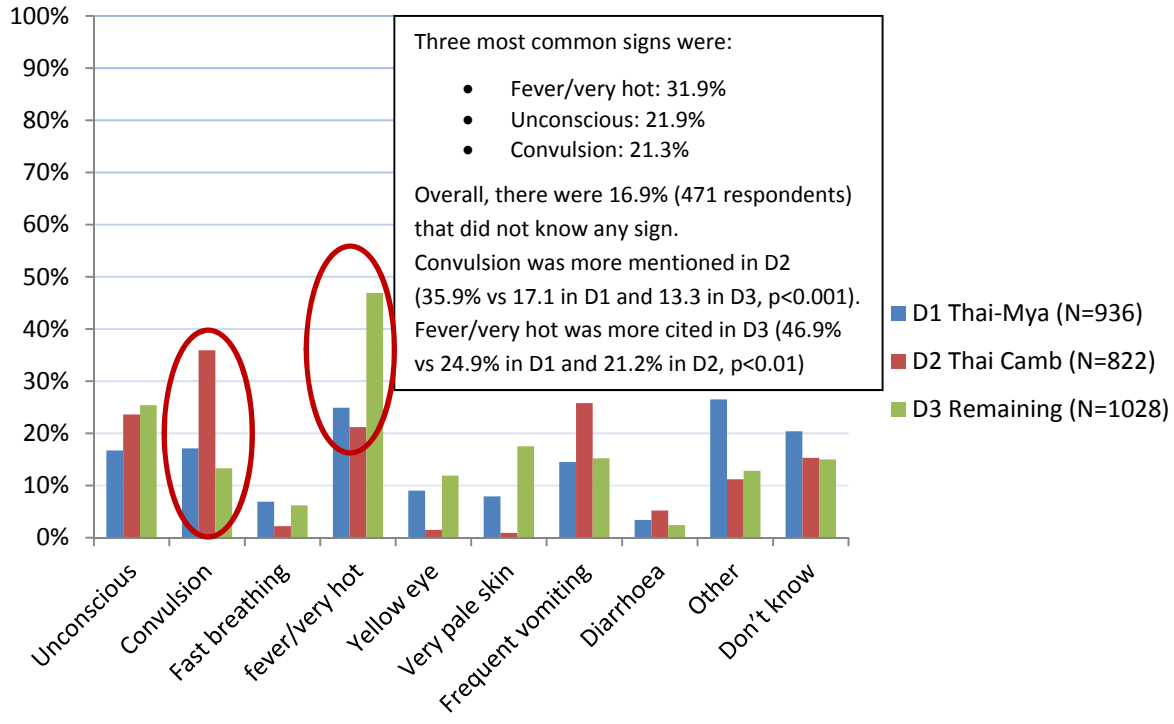
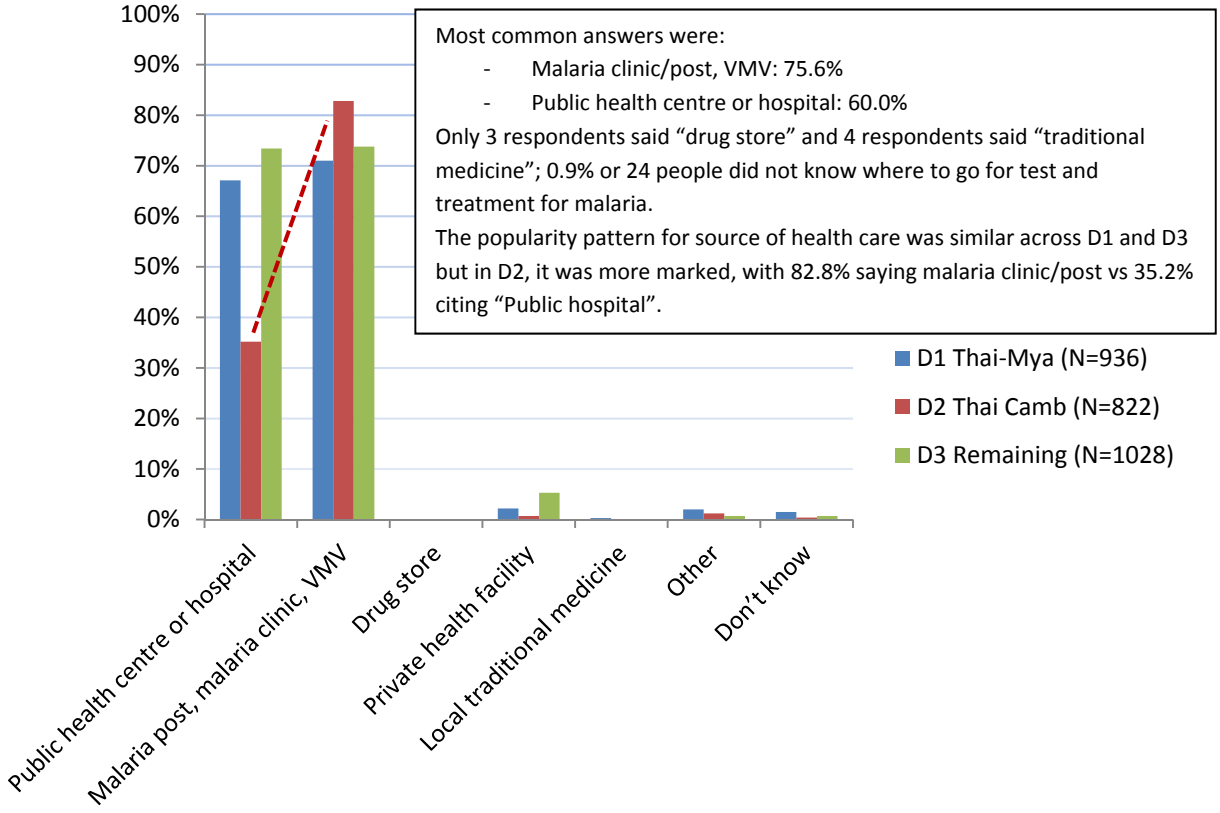


**Figure 3.4.6 Awareness of source for malaria test and treatment (N=2786)**

*Multiple answers possible*




3. 5 CAMP SURVEY RESULTS

**Table 3.5.1: Description of the people living in the 225 sampled households (N=1,210)**

| Background characteristic | n | % |
|---|---|---|
| **Age categories** | | |
| Children under 5 | 128 | 10.6 |
| 5 to 14 years | 365 | 30.2 |
| 15 years or more | 717 | 59.3 |
| **Sex** | | |
| Male | 600 | 49.6 |
| Female | 610 | 50.4 |
| **Currently pregnant** | | |
| Yes | 19 | 1.6 |
| No | 1191 | 98.4 |
| **Ethnicity** | | |
| Karen Ni | 954 | 78.8 |
| Burmese | 52 | 4.3 |
| Shan | 2 | 0.2 |
| Mon | 27 | 2.2 |
| Kachin | 8 | 0.7 |
| Pao | 5 | 0.4 |
| Rakhine | 2 | 0.2 |
| Muslim | 40 | 3.3 |
| Chin | 16 | 1.3 |
| Indian | 103 | 8.5 |
| Don't know | 1 | 0.1 |
| **Resident status** | | |
| Temporary visitor | 20 | 1.7 |
| Resident | 1157 | 95.6 |
| Don't know | 33 | 2.7 |
| **Stayed at home last night** | | |
| Yes | 1045 | 86.4 |
| No | 165 | 13.6 |

A total of 1210 individuals were found in the sampled households in the camps and among these people, 30.2% were children under five years of age. The gender balance was nearly 50% and 19 women reported being pregnant at the time of the survey. The majority of the sampled population belonged to the Karen Ni ethnic group (78.8%) and most of them were resident in the households (95.6%) as opposed to temporary visitors (1.7%) and 86.4% stayed in the house the night before the interview. Lastly, the average household size was 5.38 ranging from 1 to 14 people.

**Table 3.5.2: Net ownership on the survey day (N=225)**

| Indicator | n | % (95%CI) |
|---|---|---|
| Hh with any net | 224 | 99.6<br>96.3 to 99.9 |
| Hh with any net currently not used | 108 | 48.0<br>37.5 to 58.7 |
| Hh with 1 net per 2 people or better | 144 | 64.0<br>57.0 to 70.5 |
| Hh with all members protected last night by net or wire screen | 213 | 94.7<br>89.9 to 97.2 |

Almost all households possessed at least 1 net of any type but 48.0% of households owned any net that was stored away and not being used for sleeping at the time of the survey. However, only 64.0% of households had one net for every 2 people or better, as currently recommended to ensure universal access. On the other hand, 94.7% of households had all members protected by a vector control methods.

**Table 3.5.3: Average number of net owned on the survey day**

| Indicator | Mean | Range |
|---|---|---|
| Any net | 2.93 | 1 to 7 |
| Net not used for sleeping | 1.47 | 1 to 5 |
| Net users last night if net used | 2.10 | 1 to 6 |

This table confirms that households own on average 1.5 net that are stored and not used for sleeping while the average number of users if the net was used last night was 2.10. This is probably due to the proportion of individuals using alternative protection methods.

**Table 3.5.4: Characteristics of household nets (N=656)**

| Indicator | n | % |
|---|---|---|
| **Net observed by interviewer** | | |
| Yes | 607 | 92.5 |
| No | 49 | 7.5 |
| **LLIN** | | |
| Yes | 435 | 66.3 |
| No | 221 | 33.7 |
| **ITN** | | |
| Yes | 437 | 66.6 |
| No | 219 | 33.4 |
| **Net used last night** | | |
| Yes | 494 | 75.3 |
| No | 162 | 24.7 |

These results tell us that nearly all insecticide treated nets were LLIN as opposed to treated net using an insecticide treatment kit. Three quarters of net were used the previous night, which is coherent with the fact that a significant proportion of households possessed a net that was not used for sleeping at that time.

**Table 3.5.5: Net use the previous night for people who stayed in the house, by net and background characteristic**

| | Net of any type | | | Insecticide treated net (including LLIN) | | |
|---|---|---|---|---|---|---|
| Indicator | n | Proportion | 95%CI | n | Proportion | 95%CI |
| **People that used a net last night** | | | | | | |
| Net use (N=1045) | 1015 | 97.7 | 94.8 to 98.4 | 655 | 62.7 | 56.1 to 68.8 |
| **Age category** | | | | | | |
| Under 5 (N=121) | 118 | 97.5 | 92.1 to 99.3 | 71 | 58.7 | 49.7 to 67.1 |
| 5 to 14 years (N=330) | 322 | 97.6 | 94.6 to 98.9 | 233 | 70.6 | 64.0 to 76.4 |
| 15 years or more (N=594) | 594 | 96.8 | 93.8 to 98.4 | 594 | 59.4 | 51.5 to 66.8 |
| **Sex** | | | | | | |
| Male (N=500) | 486 | 97.2 | 94.1 to 98.7 | 324 | 64.8 | 58.1 to 71.0 |
| Female (N=545) | 529 | 97.1 | 94.4 to 98.5 | 333 | 61.1 | 53.5 to 68.2 |
| **Residency status** | | | | | | |
| Temporary visitor (N=17) | 16 | 94.1 | 58.7 to 99.4 | 12 | 70.6 | 45.7 to 87.2 |
| Resident (996) | 967 | 97.1 | 94.8 to 98.4 | 620 | 62.2 | 55.3 to 68.7 |
| Don't know (32) | 32 | All | - | 25 | 78.1 | 43.6 to 94.3 |
| **Ethnic minority** | | | | | | |
| Karen Ni (N=817) | 792 | 96.9 | 94.2 to 98.4 | 531 | 65.0 | 57.7 to 71.7 |
| Other ethnic group (N=228) | 223 | 97.8 | 90.2 to 99.5 | 126 | 55.3 | 33.6 to 75.1 |

The assessment of net use the previous night confirms that household have sufficient net of any type as almost all individuals slept under a net (97.7%). However, this proportion fell under the target of 80% for ITN use, with only 62.7%. It is worth remembering that the people not protected by an ITN might have used other prevention methods such as living in a household with wire screen. ITN use seemed higher among people from 5 to 14 years old but lower among children under five. It is interesting to observe that use of net of any type was higher among resident but lower among visitors (97.1 vs. 94.1%). However, the pattern reversed for ITN use with only 62.2% of resident using an ITN compared to 70.6% of visitors. This tendency also found in the rest of the population in Thailand might suggest that people prefer using untreated nets and keep the ITN for visitors.

**Table 3.5.6: Household coverage of BCC activity**

| Indicator | n | Proportion | 95%CI |
|---|---|---|---|
| Received any malaria message in past 6 months (N=225) | 88 | 39.1 | 29.3 to 49.9 |
| **Among these household, message content remembered** (N=88) *Multiple answers possible* | | | |
| Sleep under a net | 50 | 56.8 | 46.0 to 67.0 |
| Sleep under an ITN | 13 | 14.8 | 6.8 to 29.2 |
| Use ITN or hammock net when outside | 2 | 2.3 | 0.5 to 9.7 |
| Go for test if malaria suspected | 0 | - | - |
| Complete malaria treatment | 3 | 3.4 | 1.1 to 10.0 |
| Personal protection reduce malaria risk | 1 | 1.1 | 0.1 to 9.7 |
| Other | 29 | 33.0 | 25.7 to 41.1 |
| **Source of information** (N=88) *Multiple answers possible* | | | |
| NGO, health facility | 46 | 52.3 | 39.0 to 65.2 |
| Home visit | 23 | 26.1 | 17.3 to 37.5 |
| Community activities | 2 | 2.3 | 0.3 to 15.9 |
| School | 2 | 2.3 | 0.5 to 10.4 |
| Religious facility | 0 | - | - |
| Family / friends | 9 | 10.2 | 3.9 to 24.4 |
| Poster | 0 | - | - |
| Leaflet / brochure | 4 | 4.5 | 0.8 to 22.6 |
| Television | 0 | - | - |
| radio | 0 | - | - |

The coverage of BCC activity was similar to what was observed among households living outside the camps (39.1% vs. 37.5%). The content of message that was most remembered was related to net or ITN use while there was little emphasis on malaria diagnosis and treatment. Also, the most popular source of message was NGO or health facilities while printed BCC materials remained quite an uncommon source of information.

**Table 3.5.7: History of malaria in past 12 months**

| Indicator | n | Proportion | 95%CI |
|---|---|---|---|
| Had malaria in past 12 months (N=1210) | 33 | 2.7 | 1.8 to 4.1 |
| **Species** (N=33) | | | |
| Plasmodium falciparum | 1 | 3.0 | 0.4 to 21.5 |
| Plasmodium vivax | 5 | 15.2 | 5.5 to 35.4 |
| Don't know | 27 | 81.8 | 54.9 to 94.3 |
| **Sought treatment** (N=33) | | | |
| NGO clinic | 28 | 84.8 | 67.9 to 93.7 |
| Self-treatment | 1 | 3.0 | 0.3 to 22.8 |
| Don't know | 4 | 12.1 | 4.3 to 29.5 |

Out of the 225 sampled households, 7 (=3.1%) bought any antimalarial in or around the camp; the source of treatment was as following: Ba Kar outside the camp (n=1), in Myanmar (n=2), Indian medicine in shop in the camp (n=1), Shop in Karen state (n=1), Mae Sot (n=1) and Shop in the camp (n=1).

# 4. DISCUSSION

*Malaria and reported fever prevalence*

Malaria prevalence based on microscopy the survey day was lower than the 0.5 to 1.5% anticipated. Only two out of the 10,834 individuals in the sampled households were identified as malaria positive by microscopy. Both cases were adults over than 14 years old and lived in Domain 3. One case was P. falciparum and the other was P. vivax. Malaria prevalence based on PCR was 0.1% (7 cases). People positive for malaria through PCR were found in all three domains and were all adults over than 14 years old. Four were identified as P. falciparum and 3 were P. vivax. Interestingly, none of the cases reported any fever episode in the previous two weeks. Six out of the infected people were from a poor socio economic background (quintiles 1 or 2) and seven of them were Thai, compared to only one migrant (M2). Half of the malaria cases reported having an activity involving some exposure to malaria risk such as working in the forest or travelling away from home. None of these people used an insecticide treated net (ITN) the night before the survey, only 1 of them was living in a household with sufficient ITN to ensure universal access and only one was living in a household where the respondent remembered any of the behaviour change communication (BCC) messages. Serological results are not yet reported, as analysis is ongoing. The prevalence of reported fever episodes in the whole surveyed population in the previous two weeks was 4.2% and that proportion was higher at the Thai Myanmar border with 5.3%. As one would expect, children under five years of age were more likely to have been affected by a recent fever episode (12.1%, $p<0.001$) compared to older age categories.

*Malaria prevention*

The level of knowledge and awareness of malaria of the population living in the survey area (A1 and A2 villages) was quite poor; 47.3% of respondents knew malaria is transmitted by *Anopheles* bite but 18.2% mentioned a wrong transmission mode and 16.2% did not know. Some 44.4% of respondents mentioned at least one other prevention method in addition to using a net while only 10.6% said using an insecticide treated net (ITN) and 16.8% did not know any advantage of using ITNs. The level of knowledge of people living at the Thai Cambodia border appeared higher than the rest of the country, which is encouraging considering the recent efforts to reduce malaria transmission in these villages. For example, 80% of respondents in that area knew that ITNs repel mosquitoes.

Household ownership of ITNs was insufficient to ensure universal access for all household members; 92.2% of households owned at least one mosquito net of any type at the time of the survey but only 46.5% owned any ITN. Household ownership of sufficient nets defined as one net for every 2 people was 79.1% for nets of any type, 28.6% for ITNs and 20.9% for LLINs. In general, net ownership was higher at the Thai Cambodia border and lower in Domain 3[5]. Poorer households were more likely to own a net and this trend was most marked for LLINs. Nearly two thirds (64.0%) of nets were untreated and only a quarter (26.1%) of all nets were LLIN. Out of all nets, 58.9% were acquired less than 2 years ago; 54.5% were bought in a shop or the local market and 24.4% were distributed by

[5] Domain 1= Thai Myanmar border; Domain 2 = Thai Cambodia border; Domain 3 = remaining provinces

the government or the village health volunteer. The most important determinant for a household to buy a new net was insufficient quantity of nets owned (1 net for every 2 people). Even if these households would be more likely to buy a new net, 38.7% would not know where to go and 20% considered that they had enough nets even if the ratio of nets per people was less than 1:2. Household coverage of other methods for prevention included Indoor Residual Spraying (IRS) with 38.8% houses sprayed in past 12 months, mosquito repellent usage (35.4% of households) and to a lesser extent mosquito wire screen usage on windows (5% of households). The proportion of households protected by either IRS or owing sufficient ITN was 54.6% and this proportion was higher at the Thai Cambodia border with 73.4%.

Looking at actual net use the night before the survey, 79.9% of all people living in sampled households slept under a net and 28.7% used an ITN[6]. Several factors were found to be determinants for net use. People living at the Thai Cambodia border were more likely to use a net of any type as well as ITN. The poorest people were also more likely to use an ITN and a LLIN compared to other wealth quintiles. It was worrying that net use in households with at least 1 ITN for every 2 people was 39.9%, still far below the 80% target established under Thailand's GFATM Round 10 programme, even if people had theoretically enough nets for universal access. However, the high use rate of any net including untreated nets indicates an encouraging continued demand for nets. The most common reasons for not using nets were subjective with 44.8% answering feeling hot or discomfort and this was true for all domains.

Out of all sampled households, 37.5% of household respondents had heard any information on malaria in the previous 6 months and the coverage was even lower in the 2 domains at the borders with Myanmar and Cambodia. Messages most remembered were "Sleep under an ITN" with 40.0%, "Get tested if malaria suspected" with 39.6% and "Complete treatment" with 14.9%. At the Thai Cambodia border, the message relating to malaria testing was far less mentioned with only 21.2%. Most common sources of information were "Village Health Volunteer (VHV) /malaria post or clinic" with 68.9% and "Malaria clinic/Vector-borne Disease Unit (VBDU) staff" with 34.5%. At the Thai Cambodia border, sources of message were more diverse and included channels specific to BCC activities such as leaflets and posters but interpersonal communication with family, friends, relatives or neighbours was higher in villages with fewer BCC channels such as in Domain 3. It was very encouraging to find that BCC messaging had an impact on the behaviour of people working in the forest in terms of net use the last time they visited the forest.

*Malaria case management*

Treatment seeking of reported fever cases in the previous 2 weeks was quite high with 77.4% having gone to a health provider of any kind and 73.4% of them doing so within 48 hours. The 2 major sources of health care were public health facilities (66.0%) and private health facilities (19.8%). It was encouraging to see that a drug store was not a popular source for health care with only 10 cases (2.8%) seeking treatment from there. In the same way, knowledge of sources for malaria testing and treatment was really encouraging with the vast majority of respondents mentioning malaria posts or public health facilities. However, 73.8% of the 22.6% people (=76 individuals) not seeking treatment

[6] ITN include LLIN based on commercial brand and net treated with an insecticide within the past 12 months.

actually preferred using traditional medicine and this proportion reached more than 95% at the Thai Cambodia border.

Awareness of malaria risk was quite low considering the threat of artemisinin resistance; 44.8% of household respondents felt at risk for malaria. It was interesting that at the Thai Cambodia border, respondents were less likely to have ever heard of malaria (79.9%) but if they did, they were more prone to mention malaria as one of the top three causes of fever (43.0%). This strongly suggests that recent BCC efforts in these villages had some impact in raising general awareness. On the other hand, only a third of respondents (33.2%) felt at risk of malaria at the Thai Myanmar border, which is worrying considering population movements across the border and the higher malaria transmission levels in some part of Eastern Myanmar.

Among reported fever cases that sought treatment, only 15.9% had a test for malaria. This was not surprising as the level of knowledge about malaria diagnostic services was poor. Out of all sampled respondents, only 16.2% said they would confirm malaria diagnosis through a blood test, as currently recommended. Knowledge of malaria signs and symptoms among people that had ever heard of malaria was quite high in Domain 3 but lower in the border areas. For example, fewer than 60% of respondents in these villages mentioned fever as a malaria sign; overall, 9.2% did not know any sign or symptoms. These low percentages may reflect the declining experience of malaria in the communities.

*Camp survey*

While nearly all households sampled in the three camps owned at least one net of any type (99.6%), the coverage of sufficient net ownership fell below the target of 80% and reached only 64.0%. This was lower than the coverage estimated among households outside the camp (76.7% at the Thai Myanmar border). However, these results should be interpreted with consideration of other prevention methods. Indeed, the night prior to the interview, 94.7% of households in the camps had all their members protected by a net or wire mosquito screen. In the same way, the vast majority of household members actually used a net the previous night, with 97.1% which was higher that net use in households outside the camp (79.9%). The facts that 48.0% of households stored a net at the time of the survey and high proportion of net use confirms that householders owned enough nets at that time, considering sleeping habits. It also suggests that there is a strong net culture among these communities and that people value nets. It is worth noting that 66.0% of all nets were treated with insecticide. Finally, the coverage of BCC messages was similar to what was found in households outside the camps (39.1 vs. 37.5%) and the messages most remembered were related to prevention methods and more specifically net use.

In conclusion malaria prevalence in areas of concern for artemisinin resistance is very low as measured both by microscopy and standard PCR, which is very encouraging. While the survey was undertaken during the malaria transmission season, some of it was towards the end and after the usual peak. Whilst use of any net is high the use of treated nets is not at the target levels. The challenges of maintaining awareness of malaria at very low transmission levels are noted, but knowledge of sources of malaria testing and treatment remains high.

# 5. KEY RECOMMENDATIONS

1. **Reinforce BCC efforts to raise awareness of malaria prevention and case management**

   General knowledge of malaria such as how it is transmitted and risk factors like working in the forest were found to be low. Considering the low level of malaria transmission, population awareness is likely to drop further without particular efforts to raise and maintain appropriate level of knowledge, attitude and practice to prevent the spread of artemisinin resistance and the reintroduction of malaria in areas where it has been eliminated.

   Uptake of insecticide treated nets was particularly low compared to the high use rate of untreated nets, even in households that owned enough ITNs to ensure all members could access them. This indicates that BCC efforts should emphasize the importance of using ITNs for malaria prevention. Promoting ITN use to reach the Roll-Back Malaria (RMB) target (of at least 80% of the population) is essential to impact on malaria transmission and thus maximising the of ITNs that were recently distributed on malaria transmission. High coverage and use is especially important in areas where net efficacy is compromised by vector biting habits to ensure the repellent and knock down effects are maximised.

   Areas for further BCC activity intensification include the confirmation of malaria diagnostic by a blood test and the prompt treatment using recommended drugs following the treatment duration. These messages should not only be spread by health care providers but also in the communities to ensure appropriate health seeking behaviour of fever cases. It is especially important to maintain a high awareness of malaria as a cause of fever that needs appropriate diagnosis and treatment, especially in a situation where the cause of the fever is much less likely to be malaria, but where if the fever is malaria urgent and effective treatment is needed to prevent the spread of drug resistance. This may be a difficult message to convey.

2. **Expand the availability and promote the use of appropriate preventive methods**

   Household coverage of any ITN or LLIN was insufficient to impact on malaria prevention and transmission. Considering the high household coverage of at least one mosquito net, the national malaria prevention strategy could explore the role of short to medium-term approaches for net retreatment kits or campaigns. For the longer term, strategies should be in place to promote the replacement of current conventional mosquito nets, building on the existing opportunity of the “net culture” in Thailand.

   The scale up of ITNs as prevention methods should be complemented by personal protection methods such as mosquito repellents. This is important to prevent malaria transmitted outdoor and particularly for more exposed groups such as migrant workers

staying in the forest. These should be promoted and made accessible especially in bordering area.

**3. Promote malaria testing of all suspected malaria cases**

As the number of malaria cases has significantly decreased in Thailand, it is essential to reinforce the importance of confirming suspected cases using a blood test (microscopy or RDT). The standard case definition of clinical malaria[7] should be reemphasized amongst health care providers including providers of traditional medicine. On the other hand, the population should understand the importance of testing suspected cases and treating and tracking confirmed malaria patients, in this context of malaria elimination. It is crucial that diagnostic services should be available and accessible to all people in areas with ongoing malaria transmission, especially including ethnic minorities, foreigners and migrants M1 and M2.

**4. Promote innovative strategies to reach and target vulnerable groups including mobile or migrant population**

The national malaria programme should specifically address these vulnerable risk groups as they are highly at risk for malaria. They should have access to prevention methods such as insecticide treated nets or other personal prevention methods, be aware and have access to diagnostic services and malaria treatment and be sensitized on the importance of seeking health care in case of fever. Innovative strategies and approaches should be piloted to specifically address improving case management, prevention, as well as M&E and surveillance among mobile populations. Furthermore, linkages with the private sector (i.e., development projects and businesses employing migrants) should be strengthened.

**5. Increase general awareness about the threats of artemisinin resistance**

Although artemisinin monotherapies are not officially used in Thailand, the importance to stop using these treatments should be regularly emphasized. M&E activities should include the assessment of available drugs in the private sector to detect any artemisinin monotherapy, any fake or counterfeit antimalarial drugs. This is crucial to limit the spread of artemisinin resistance. Providers of traditional medicine should be engaged in these efforts as these were a significant source of health care for reported fever cases.

[7] Case definition of clinical malaria case: Fever or history of fever associated with symptoms such as nausea, vomiting, diarrhoea, headache, back pain, chills, myalgia and where other infectious diseases have been excluded.

6. **Promote better understanding of malaria epidemiology in Thailand**

The low malaria prevalence based on microscopy and PCR and reported fevers found in this survey is an encouraging testament of the progress achieved towards malaria elimination in Thailand. It confirms that robust surveillance methods are essential to measure malaria burden in this epidemiological setting. Further analysis of prevalence results using serological methods should be completed as soon as possible to complement these findings. It will be particularly important to understand better the timing of infection of these individuals. Also, better understanding on the symptomatology of malaria cases is crucial to ensure prompt diagnosis of appropriate cases or individuals. More research may also be needed to evaluate the impact of changing species distributions (i.e., increasing proportion of cases that are P. vivax) on disease transmission dynamics. Lastly, the investigation of risk factors must be pursued to identify and treat asymptomatic cases.

# 6. ANNEXES

- Questionnaire
- Evidence for PCR results (see protocol)
- Statistical parameters used in detail, along with an explanation of the cluster and sampling design (see protocol)