

# Perceptions of malaria and preventive practices used among Orang Rimba forest dwellers in Sumatra Indonesia

Ingrid Chen (✉ [Ingrid.Chen@ucsf.edu](mailto:Ingrid.Chen@ucsf.edu))

University of California San Francisco

Din Syafruddin

Eijkman Institute for Molecular Biology

Puji Budi Setia Asih

Eijkman Institute for Molecular Biology

Ismail Ekoprayitno Rozi

Eijkman Institute for Molecular Biology

Dendi Hadi Permana

Eijkman Institute for Molecular Biology

Lepa Syahrani

Eijkman Institute for Molecular Biology

Ma'as M Malaho

National Research and Innovation Agency

Syarifah Zulfah

National Research and Innovation Agency

Melawit Tekeste

University of California San Francisco

Jordan Myers

University of Notre Dame

Maiti Peters

University of Iowa

Sanjna Chetan

University of Notre Dame

Elissa Faro

University of Iowa

Roya Ghiaseddin

University of Notre Dame

Neil F. Lobo

University of Notre Dame

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## Research Article

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# Abstract

## Background

Southeast Asia aims to eliminate malaria by 2030, requiring that risk factors for malaria among hard-to-reach populations be understood and addressed. This is the first study of malaria risks on the Orang Rimba, a culturally unique nomadic ethnic group residing in the lowland rain forests of Sumatra, Indonesia that usually functions outside of the health system. This study characterizes perceptions of malaria and preventive practices used, to inform the selection of interventions that can support malaria elimination efforts for this specific and sensitive population.

## Methods

A small cross-sectional survey was conducted among the Orang Rimba people in the Sarolangun District of Jambi, Indonesia between March and May of 2021. The survey identified participant demographics, their knowledge of malaria, prevention practices in use, and pregnancy-related health behaviors among females. For cultural reasons, questions for women were asked through men.

## Results

We enrolled 39 participants, 87% of which were male. Most participants (77%) had no formal schooling, and all worked in agriculture and/or hunting. Their understanding of malaria was limited, with approximately half understanding that malaria transmission takes place through the bite of an infected mosquito, and 62% citing fever as a symptom of malaria. The vast majority of participants (90%) used mosquito coils and/or insecticide-treated bednets (ITNs) (87%) the night before the survey. Women did not perceive malaria to be a greater health risk in pregnancy, and received limited prenatal care (29%) and ITNs (46%) during their pregnancies.

## Conclusions

Orang Rimba forest dwellers in Sumatra are vulnerable, socioeconomically disadvantaged, and separated from the healthcare system. If Indonesia and the Greater Mekong Subregion are to meet their goal to eliminate malaria by 2030, deliberate and continuous efforts targeted at reducing outdoor transmission among the Orang Rimba communities will be essential. Education on malaria and the provision of prenatal care would likely benefit this community.

## Background

Southeast Asia has made tremendous progress in the fight against malaria, and aims to eliminate all forms of human malaria by 2030 [1]. In order to do so, the remaining pockets of transmission need to be addressed, most of which take place outdoors in rural and forested areas that are remote and far from healthcare [1, 2]. There is a lack of understanding on how to eliminate forest malaria, which is often associated with hard-to-reach impoverished populations often comprised of ethnic minorities [5]. Understanding the perceptions of malaria and preventive methods used among these culturally unique populations is crucial for accelerating the path to malaria elimination, through identification of gaps in protection to inform the development of tailored interventions to address those gaps. The process of using human-centered approaches to support the introduction of interventions has shown to improve implementation outcomes [3, 4].

A number of studies on Southeast Asian forest-going and dwelling populations have been conducted in recent years [3, 5–8], revealing the diversity and complexity of each forest malaria population, and the need to understand their characteristics, activities, and mobility [8]. Most of the studies conducted to date have taken place in Cambodia, Laos, Myanmar, and Vietnam. Indonesia, which is making progress towards malaria elimination, has had one study published characterizing forest workers in Aceh Sumatera [9]. We add to this evidence base by studying the perceptions of malaria among the the nomadic Suku Anak Dalam community, also known as the Orang Rimba ‘people of the forest,’ a highly sensitive nomadic ethnic group residing Sumatra, Indonesia.

The Orang Rimba people have been identified as a high-risk population for malaria by the Jambi Provincial Government of Indonesia [10], with a malaria prevalence rate of 24.6% in 2015 using PCR (Puji Asih, personal communication). Members of this community live in lowland rainforests, where there are many larval sites for mosquitoes [11], spending most of their time outdoors where subsist on swidden farming and foraging wild yams. They sleep in open shelters in temporary settlements (Fig. 1) where they have high exposure to mosquitoes [12]. Intentionally having limited interactions with outsiders [13], their cultural practices and nomadic existence keep them separated from the local healthcare system, making access to care challenging [11].

The vast majority of the Orang Rimba people live in four districts in Bukit Dua Belas National Park in Jambi; Merangin, Batanghari, Tebo, and Sarolangun, which together have approximately 2,545 Orang Rimba population members in approximately 599 households, with each

household having an average of 4 members. This small cross-sectional study seeks to understand perceptions of malaria and preventive practices amongst the Orang Rimba people, with the goal of identifying gaps in protection and developing new intervention packages that can be used to achieve malaria elimination among this unique hard-to-reach population.

## Methods

### Overview

This study comprises a cross-sectional survey on the nomadic, forest dwelling Orang Rimba group in Jambi, Indonesia, a high-risk population for malaria in Sumatra. The study identified the demographics of the study population, their knowledge of malaria, perceived severity of malaria, and malaria prevention practices in use.

### Study location and sampling

This study was conducted in the Sarolangun District, where malaria transmission is among the highest in Jambi, Indonesia (Fig. 2) [14]. The study site was selected with support from the non-governmental organization called Komunitas Konservasi Indonesia Warsi (WARSi), who conducted a census among the study population previously, identifying it as an area with high malaria transmission. The study population has worked with members of the study team at the Eijkman Institute for Molecular Biology (EIMB) in Jakarta and the Jambi Provincial Health Department since 2016, identifying this study site as having individuals who were available to participate in research, with high numbers of malaria cases and the presence of anopheline mosquitoes where they live.

#### Recruitment

For recruitment, first the head of the tribal unit known as the Tumenggung was contacted with the support of WARSi. The study team explained the purpose of the study to the Tumenggung, and if they approved of the study, the study team was given permission to meet with Orang Rimba members. The study team then convened Orang Rimba members, typically men, to explain the purpose of the research and was accompanied by a primary health center staff member who checked the health status of all members in the meeting who wanted a health check. Representative members of the Orang Rimba or people who knew them well who could read or write were then hired as research assistants to help with data collection, and were trained on informed consent procedures and survey administration for the study.

On the days in which research assistants conducted the survey, participants were visited at their temporary residential structures, where the research assistants sought informed consent with the head of the household, explaining the purposes of the research. The head of household was identified based on self-report that they were at least 18 years of age and provided income for or made decisions for their family. Each eligible participant who agreed to participate in the study was administered a survey through an oral interview by the research assistant. Due to cultural sensitivities, responses gathered by women were relayed to the survey assistant by a related man present in the household.

### Inclusion Criteria

All individuals included in the study stated they were at least 18 years of age and provided income or made decisions for the family.

### Data collection

A questionnaire examining the Knowledge, Attitudes, and Practices regarding malaria was administered to each head of household to understand community demographics, understanding of malaria transmission, perceived severity of malaria, and prevention practices used and reasons for doing so (questionnaire in Supplemental Information 1). This questionnaire also included questions focused on pregnancy related health behaviors as pregnant women are a vulnerable population for malaria, that were administered to female participants as well as female relatives of male participants. All surveys questions for females were asked through a male household member due to cultural reasons. survey responses recorded on paper forms. This data was entered into a Microsoft Excel document by survey assistants later, on password protected computers. De-identified data was sent to research assistants in other institutions, for data analysis and review.

### Data Analysis

Knowledge on malaria transmission was analyzed using a malaria knowledge scoring system (Supplemental Information 2), where the total score for each participant was collated. De-identified survey data were summarized and described.

## Results

# Cross-sectional survey

## Demographics

The study team interviewed 39 individuals who identified as head of household in the Sarolangun District of Jambi Province between March and May of 2021. Population demographics are shown in Table 2, with the vast majority (87%) of participants being male of various ages who had families comprised of three to five individuals. Most did not have formal schooling and worked in agriculture and/or hunting.

Table 2  
Demographic characteristics

Characteristics		N (%)
<b>Total participants</b>		39 (100%)
<b>Sex</b>	Male	34 (87%)
	Female	5 (13%)
<b>Participant age (years)</b>	21–30	14 (36%)
	31–40	10 (26%)
	41–50	5 (13%)
	> 50	10 (26%)
<b>Education level</b>	No formal schooling	30 (77%)
	Incomplete primary	6 (15%)
	Complete primary	1 (3%)
	Postsecondary	1 (3%)
	Other	1 (3%)
<b>Occupation</b>	Agriculture only	17 (47%)
	Hunting with or without agriculture	19 (53%)
<b>Family size</b>	0–2	4 (10%)
	3–5	28 (72%)
	6–8	7 (18%)

## Knowledge of malaria

Knowledge of malaria was assessed based on how malaria is transmitted, what the symptoms of malaria are, and how to prevent it. Malaria knowledge scores could range from 0 to 13 based on correct answers, results of which varied widely (Fig. 3).

When asked about malaria transmission the majority of participants (69%) correctly identified mosquitoes as the vector for malaria, while 49% knew that the bite of an infected mosquito was required for transmission. Some participants (21%) believed that malaria was transmitted from drinking dirty water, 21% believed it was through eating contaminated food, and 10% thought it could result from having an unsanitary home. Some participants (21%) said they did not know how malaria is transmitted. When asked about what time mosquitoes bite, half of participants stated that they did not know, while the others showed highly varied responses.

When asked about malaria symptoms, most (89%) cited shaking and chills, with most (85%) also mentioning vomiting as well. The majority (62%) mentioned high temperature or fever, 59% mentioned dizziness, around half (46%) mentioned itching, and a few (18%) mentioned the swelling of feet. Knowledge of how to prevent malaria prevention was relatively high, with the most commonly cited methods being mosquito coils (85%), insecticide-treated nets (82%), and making fire or smoke (77%). A few participants (15%) also mentioned indoor residual spraying as a malaria prevention method.

## Malaria Prevention Practices

Almost all participants stated that mosquitoes bothered them. When asked about which methods they used the night before the survey, the vast majority used multiple methods, with the most common being using mosquito coils (89%) and insecticide-treated nets (87%), as well

as burning animal manure or leaves (29%), wearing long sleeves/trousers/dress (26%), and draining stagnant water (5%) (Fig. 4). Only one participant reported not doing anything to prevent malaria the night before the interview.

Almost all participants used some combination of coils, nets, and wearing long sleeves or trousers, with their reasons for doing so summarized in Table 4. Their most common reasons for using these interventions included perceived efficacy at preventing mosquito bites (51%), that they were easy to use (35%), that they were free (24%) or cheap (19%), or that they smelled nice (11%, although the intervention(s) that smelled nice were not specified). The only two participants who did not use any of those interventions either did nothing or burned manure the night before the survey was administered.

Table 4  
Reasons for using select mosquito prevention methods

Reasons for using interventions	Total (n, %)	Burn coil (n)	Sleep under net (n)	Burn coil and sleep under net (n)	Burn coil and wear long shirt/ trousers (n)	Burn coil, sleep under net, and wear long shirt/trousers (n)
<b>Total (%)</b>	37 (100%)	4 (11%)	3 (8%)	20 (54%)	1 (3%)	9 (24%)
<b>Free</b>	9 (24%)	0	1	6	1	1
<b>Cheap</b>	7 (19%)	0	1	2	0	4
<b>Smells Nice</b>	4 (11%)	0	0	1	0	3
<b>Like the way it looks</b>	0 (0%)	0	0	0	0	0
<b>Better at stopping bites</b>	19 (51%)	2	3	9	1	4
<b>Easy to use</b>	13 (35%)	2	0	9	0	2

## Pregnancy related health behaviors

The maternal health survey was completed by 5 female heads of household and 31 female relatives who reported their answers to male participants (n = 36 women total), with main results being presented in Table 5. The perceived health risks of malaria were similar between men and women, the majority of whom recognized that malaria is a serious health risk (64%), particularly for children under five years of age (75%). Perceptions of the health risks of malaria during pregnancy (61%) were slightly lower than perceptions of malaria in general being a serious health risk (64%). For pregnancy-related health behaviors, the majority did not receive prenatal care during their most recent pregnancy (29% did), and less than half used an ITN during any of their pregnancies (46%).

Table 5  
Pregnancy related health behaviors among female participants and family members

Survey variables	Total responses (n)	Yes (n, %)	No (n, %)*
<i>Perceived health risks*</i>			
Malaria as a serious health risk	36	23 (64%)	13 (36%)
Malaria as a health risk for children under 5	36	27 (75%)	9 (25%)
Malaria as a serious health risk during pregnancy	36	22 (61%)	14 (39%)
<i>Pregnancy-related health behaviors</i>			
Used medical care during most recent pregnancy	34	10 (29%)	24 (71%)
Used an ITN during any pregnancy	35	16 (46%)	19 (54%)
*For perceived health risks, the answer no includes respondents who said they did not know			

## Discussion

The Orang Rimba are a sensitive nomadic population at high risk of malaria, and this study comprises the first published data on their perceptions of malaria and preventive methods used. Most participants (77%) had no formal schooling, and all worked in agriculture and/or hunting. Although their understanding of malaria was limited, with approximately half understanding that malaria transmission takes place through the bite of an infected mosquito, and 62% citing fever as a symptom of malaria. The vast majority of participants (90%) used mosquito coils and/or insecticide-treated bednets (ITNs) (87%) the night before the survey. Reasons for choosing interventions included perceived efficacy, ease of use, and availability, with preference given to those that were free of charge. Women did not perceive malaria to be a greater health risk in pregnancy, and received limited prenatal care (29%) and ITNs (46%) during their pregnancies.

Compared to other studies on forest-going populations in Southeast Asia, the Orang Rimba people have relatively lower levels of knowledge on malaria, and higher levels of use of malaria prevention methods [3, 5, 6, 15]. This could be due to their deliberate limited engagement with outsiders, coupled with awareness of the high risks of malaria. Following Indonesia's subnational elimination approach using various strategies tailored to local contexts [16], enabling the elimination of malaria in this outdoor forest-dwelling population in the coming years should focus on providing education on malaria, particularly amongst pregnant women, and potentially providing additional protective tools that are suitable for use in outdoor settings. Due to the sensitive nature of this population, any engagement should leverage existing relationships that have been formed with local NGOs as well as the Eijkman Institute of Molecular Biology.

In addition to providing education and access to prenatal care, reducing malaria transmission among this population will likely be accelerated using additional malaria prevention methods. The study population expressed their choice of malaria prevention methods to be centered around perceived efficacy, ease of use, and provision free of charge. Following these criteria and the need for interventions appropriate for outdoor nomadic individuals, one option could be the use of topical repellents, which are commercially available and have demonstrated efficacy, reducing the odds of PCR-detectable malaria infection when distributed to 116 villages in Myanmar [17] and reducing malaria infection rates and mosquito density when given to 198 participants in a refugee camp in Northeastern Kenya [18]. Daily compliance may be a challenge however, as speculated when topical repellents were distributed to individuals in 117 villages in the Ratanakiri Province Cambodia [19].

Additional options for outdoor malaria prevention among forest-going populations include the use of insecticide-treated clothes [20], the use of endectocides to treat livestock [21], or the use of volatile pyrethroid spatial repellents, a product class not yet available on the market but that may soon be promising due to high user acceptability amongst villagers [15] and forest-going populations [20] in Mondulkiri Province, that provided 34.1% protective efficacy against related *Aedes*-borne viral diseases when distributed to 2,907 households in Iquitos, Peru [22]. Volatile pyrethroid spatial repellents may be promising to this population because they are easy to use, being similar to insecticide-treated coils but longer lasting without the need for frequent user activation. The vector control product classes suggested here are safe for humans and have demonstrated an ability to reduce mosquito bites [15, 23–26]. Another option is to provide chemoprophylaxis, a method shown to be effective for forest-going populations in Cambodia [27] that could be delivered with vector control interventions to further improve impact [27, 28].

Once appropriate interventions for outdoor mosquito control are identified for the Orang Rimba people, we recommend the use of social behavior change communication strategies to provide education on malaria as well as the ability of select products to offer protection, an effective method that has shown to be well-liked for malaria education, introducing new interventions, and increasing uptake [20]. Educational efforts should emphasize the risks of malaria during pregnancy as well as the benefits of receiving ITNs and prenatal care, all of which are opportunities for malaria education identified in our maternal health survey. Interventions should be subsidized and ideally made available free of charge, an important factor for the selection of vector control methods identified in our study.

Limitations of our study include our small sample size ( $n = 39$ ), and that females were not directly interviewed in this study. However, these results offer a substantial contribution to the evidence base on hard-to-reach populations because this study offers the first data in an academic study investigating malaria perceptions and practices on this population. As such it raises awareness on this community and opens avenues for further research to improve the health of members of this sensitive community. Future research on this population can explore the use of culturally sensitive data collection methods that allow for more direct inclusion of female perspectives.

In conclusion, the Orang Rimba forest dwellers in Sumatra are vulnerable, socioeconomically disadvantaged, and separated from the healthcare system. If Indonesia and the Greater Mekong Subregion are to meet their goal to eliminate malaria by 2030, deliberate and continuous efforts targeted at reducing outdoor transmission among the Orang Rimba communities will be essential.

## Declarations

**Ethics approval and consent to participate:** The study protocol was approved by the University of Notre Dame Institutional Review Board and the Ethics Committee of Research in Health, Medical Faculty of Hasanuddin University, Makassar, Indonesia. Informed consent was sought by each participant prior to enrollment. To thank them for their participation in the study, each participant received a bed net. Findings from this study are intended to guide strategic considerations for the National Ministerial Decree on Malaria Elimination.

**Consent for publication:** not applicable.

**Availability of data and materials:**

All data generated or analysed during this study are included in this published article and its supplementary information files.

**Competing interests:**

The authors declare that they have no competing interests.

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**Author's contributions:**

NFL designed and led the study. DS and PBSA led the implementation of the study with the team comprising IER, DHP, LS, MMM, and SZ. MT, JM, MP, SC, MT, EF, RG, and IC analyzed data for the study. IC wrote the first draft of the manuscript. All authors reviewed the manuscript.

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## Figures





**Figure 1**

**Open shelters used by the Orang Rimba of Jambi, Indonesia.**

The Orang Rimba are nomadic and sleep in shelters where they have high exposure to mosquitoes.

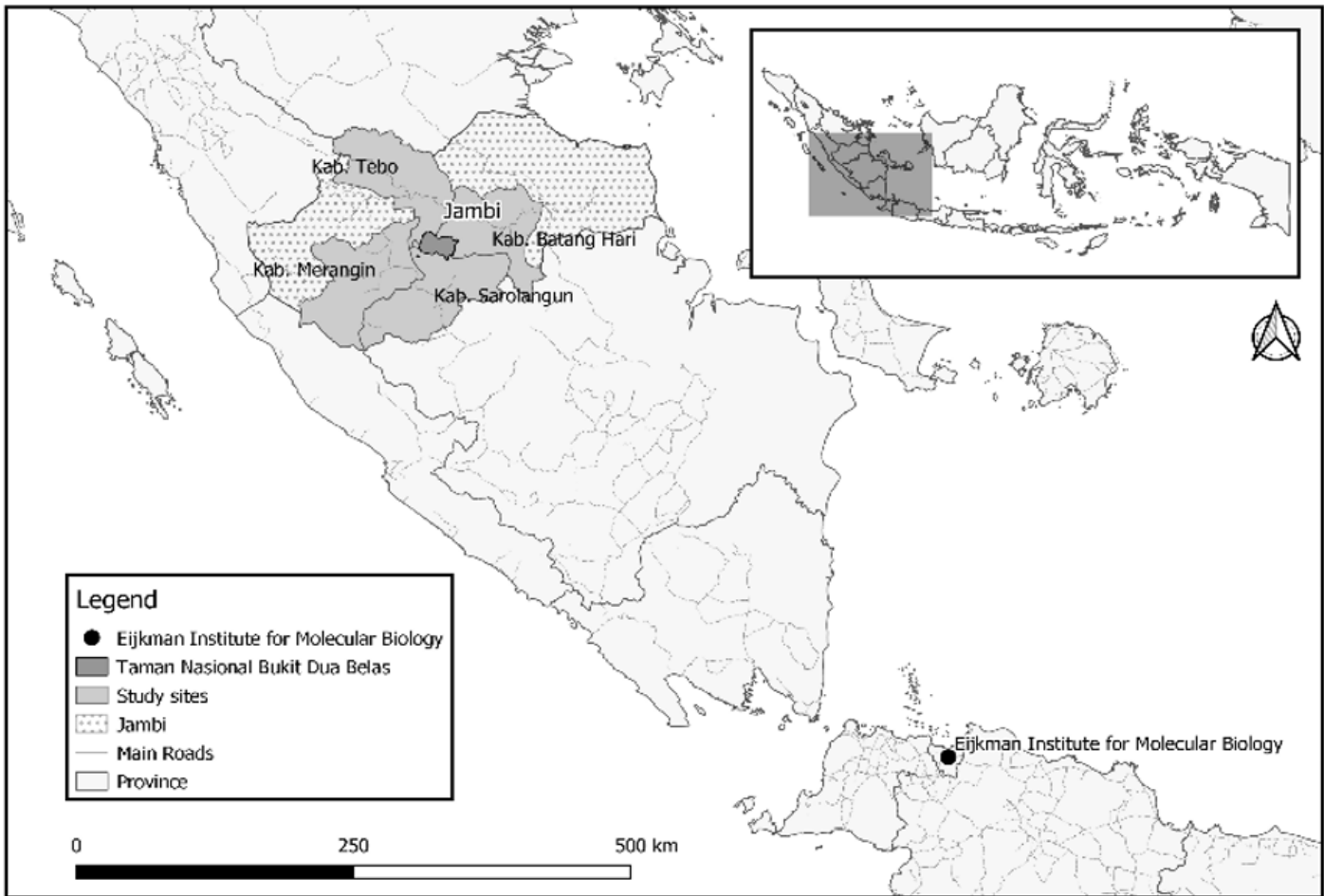


Figure 2

Map of Indonesia including study site in Jambi [12].

The study was conducted in Jambi province, Indonesia, where the Orang Rimba people reside.

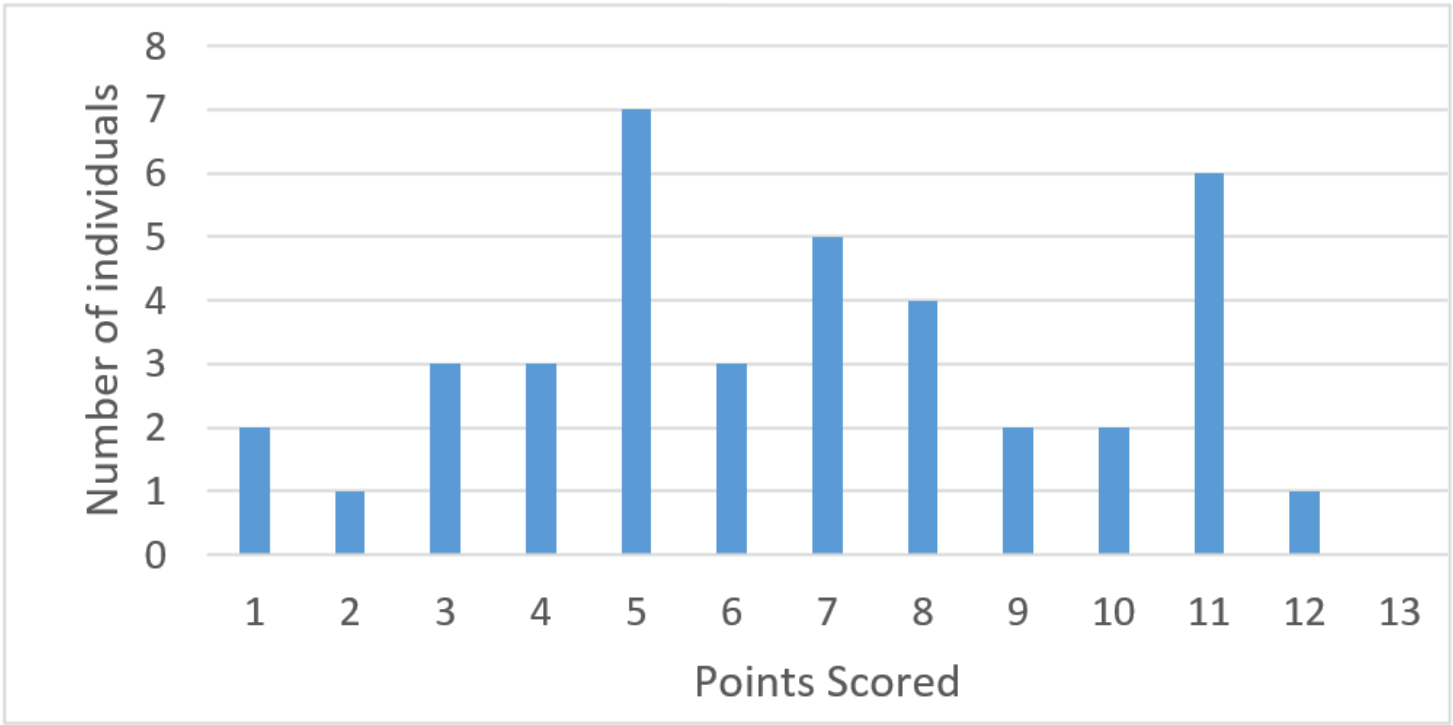
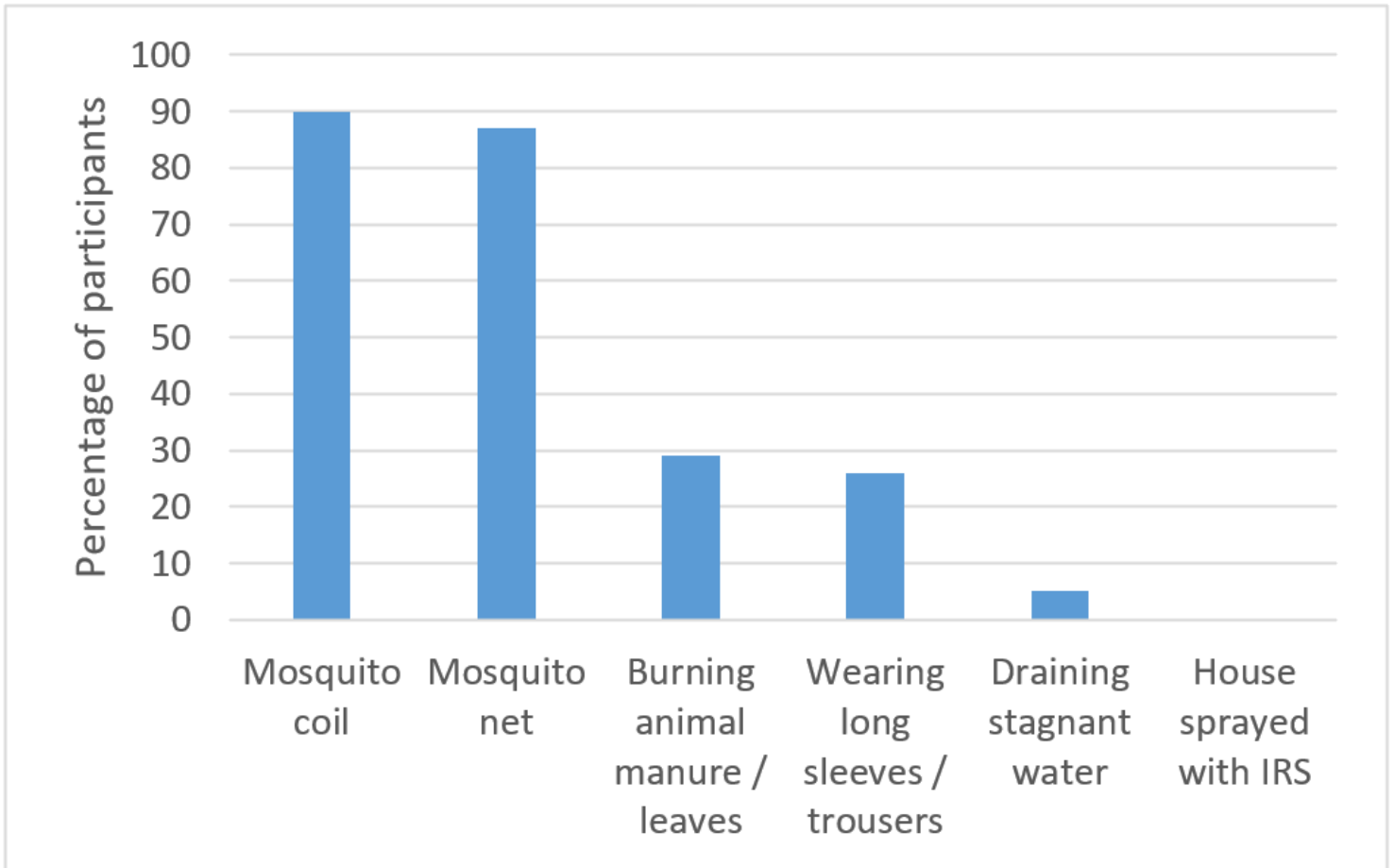


Figure 3

**Malaria knowledge scores**

Malaria knowledge scores range from 0 to 13, with higher numbers representing increased knowledge on malaria.



## Figure 4

### Malaria prevention practices used the night before the interview

Study participants reported using these methods to prevent malaria the night before the interview.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Appendix1Malariaknowledgescoringsystem.pdf](#)
- [Appendix2Supplementalfilesurvey.pdf](#)