

Malaria in children and women of childbearing age: prevalence and knowledge in the province of Nyanga, Gabon

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Research

Keywords: Malaria, prevalence, preventive measures, pregnant women, children, Gabon, Nyanga

Posted Date: June 5th, 2020

DOI: <https://doi.org/10.21203/rs.2.22550/v2>

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Version of Record: A version of this preprint was published on November 2nd, 2020. See the published version at <https://doi.org/10.1186/s12936-020-03411-5>.

Abstract

Background: There is little information on the social perception of malaria and the use of preventative measures in Gabon, especially in rural areas. Adequate knowledge of malaria prevention and control can help in reducing the burden of malaria among vulnerable groups, particularly pregnant women and children aged under 5 years old living in malaria endemic settings. This study was designed to assess the prevalence of malaria and the knowledge and attitude towards this disease in households in the Nyanga Province.

Methods: A cross-sectional study was conducted to assess malaria knowledge, prevention practices and prevalence of the infection in five departments of the Nyanga Province. Malaria infection was confirmed using rapid diagnostic tests. A questionnaire was administered randomly to 535 households during a two weeks period in March 2018. Overall, the respondents' socio-demographic characteristics, knowledge on malaria, malaria prevention practices and malaria prevalence were evaluated and compared across the five departments.

Results: Data was collected on 1,307 participants were included in this study, 631 women of childbearing age (including 61 pregnant women) and 676 children. Practically the entire (97.7%) interviewed population had already heard about malaria and attributed the cause of malaria to a mosquito bite (95.7%). This survey revealed that the bed net coverage rate was 73.3%. The study observed an average malaria parasite prevalence of 13.9%. All departments of Nyanga province had significant level of malaria infection except for the Mayumba department where no plasmodial infection was found. The overall prevalence of the plasmodial infection was significantly higher in children and pregnant women compared to adults in the cities of Tchibanga and Moabi.

Conclusion: Malaria is highly prevalent in the province of Nyanga. Our findings show that children under five and pregnant women are more vulnerable to malaria in this area of the country. This study reveals that respondents have a high knowledge of mode of transmission, malaria symptoms and preventive measures. Despite this high level of knowledge of the disease and its preventive measures, the incidence of malaria remains relatively high in this rural community highlighting the need for continuous strategic interventions particularly health awareness and educational programs

Background

In 2019, malaria remains the deadliest parasitic disease for human beings. An estimated 228 million cases of malaria occurred worldwide in 2018, most of which were in the WHO African Region (200 million or 92%). The same year, 405,000 malaria-related deaths were recorded. Children under 5 years old are the most vulnerable group affected by malaria, in 2017 they accounted for 61% (266 000) of all malaria deaths worldwide [1]. It is now known that pregnant women are more susceptible to malaria than their non-pregnant peers [2]. Malaria during pregnancy is responsible for serious consequences for both the mother and her child, among which fetal growth restriction, prematurity and still birth contribute to

perinatal and neonatal mortality [3]. In areas where the intensity of transmission is moderate to high, leading to higher levels of acquired immunity, most *P. falciparum* malaria infections during pregnancy remain asymptomatic and are frequently undiagnosed and untreated [4]. The 2018 malaria report also reveals insufficient levels of access and adherence to lifesaving malaria prevention tools and interventions. A considerable proportion of people at risk of infection are not being protected, including pregnant women and children in Africa [1].

Gabon is a hyperendemic area in which malaria burden fluctuates. Transmission is perennial since the equatorial climate favors mosquito proliferation and larval development.

However, over the last decade, Gabon has gradually strengthened malaria control interventions. Changes in the national antimalarial policy such as the introduction of artemisinin-based combination therapy (ACT) as first-line treatment in all public facilities, the introduction of malaria rapid diagnostic tests (RDTs), the distribution of impregnated bed nets, and the implementation of intermittent preventive treatment during pregnancy have led to a decline in the malaria burden in urban areas [5]. After the implementation of artemisinin-based combination therapies (ACTs) in 2005, a decrease in malaria burden was observed, but for the past few years, a recrudescence was noted in the urban areas of Franceville and Libreville. However, prevalence did not change in rural areas [6].

Nyanga is the southernmost province among Gabon's nine provinces with a population of 52,854 inhabitants. The provincial capital is Tchibanga, which had a total of 31,789 inhabitants in 2013 (more than half of the total population in the province). Nyanga is the least populated province of the nine provinces and the second least developed, following Ogooué-Ivindo. The Nyanga province has poor economic development, few industries are present and it is surrounded by forest and crossed by several rivers. Nyanga is divided into 6 departments: Basse-Banio (7,192 inhabitants), Douigny (5,235 inhabitants), Doutsila (4,331 inhabitants), Haute-Banio (1,413 inhabitants), Mongo (2,602 inhabitants) and Mougoutsi (31,789 inhabitants).

As malaria control interventions are increased, rational approaches are needed to monitor their impact over time. However, the prevalence of malaria has not been well described in the rural Nyanga province as very little data on the epidemiology of malaria is available. Furthermore, little efforts have been placed on examining the inhabitants' knowledge regarding malaria transmission modes and the preventive methods used and practiced among people living in rural communities, particularly in the Nyanga province.

To truly fight malaria in the world, a comprehensive approach that includes vector control measures and early diagnosis and treatment, especially at the village level, is needed. Using this approach, the American NGO Medical Care Development International (MCDI) has been able to significantly reduce the burden of malaria in Equatorial Guinea in recent years [7].

This study piloted an active screening approach to monitor malaria prevalence in two target populations: women of childbearing age (including pregnant women) and children under five years old. Additionally,

their knowledge on malaria was evaluated as well the behaviors of the children's parents or guardians and of the women regarding the disease in the Nyanga Province.

Methods

Population and study sites

This community-based cross-sectional descriptive and analytical epidemiological study was conducted from March 18th to 27th 2018 in the five department capitals of the Nyanga province, located in southern Gabon, to assess malaria prevalence as well as the population's basic knowledge on malaria and their behavior regarding prevention, as well as malaria prevalence. The cities included in this study were: Mayumba, Moabi, Mabanda, Moulengui-Binza and Tchibanga, respectively, in the departments of Basse-Banio, Douigny, Doutsila, Mongo and Mougoutsi respectively (Figure 1).

The studied population in this study was composed of children aged 5 years or less and women of childbearing age. Inclusion criteria set for sampling eligible participants stipulated that participants must: 1) reside within the study site during the study period; 2) have signed the consent form; 3) be children aged 5 years old or less, and be women aged 15 to 49 years. All women aged 15-49 years old and children aged 5 years or less in the households surveyed were included in the study. The study was approved by the Gabonese National Ethics Committee (N° 001/PR/SG/CNE/2018).

Sampling of study participants and collection of data on malaria knowledge and use of preventive measures against malaria and level of knowledge of participants.

Before our sampling, we identified all households with children \leq five years of age and women of childbearing age. Then a random sample of households was selected for inclusion in the study; all neighborhoods of the departmental capitals were represented. If no member from a selected household was willing to participate, the teams approached the next house on the list until reaching a willing household. The households visited were marked with chalk. The survey was performed by ten teams of three persons deployed across the five cities. The sample size was not calculated as an open sampling method was used.

Data on the use of bed nets and insecticides, and some information on education and knowledge of malaria were collected with a questionnaire (Supplementary Material). The parents/guardians of children under 5 years old, woman of childbearing age and pregnant women were asked whether they slept under bed nets and whether they sprayed insecticide in their houses. To determine their level of education on malaria, we asked some key questions such as: "Have you ever heard of malaria?", "How is malaria transmitted?", "Do you know the modes of transmission of malaria?", "How could you avoid malaria?", and "What are the symptoms of malaria". Participants that responded correctly to these questions were considered as having a basic knowledge of malaria.

Malaria parasite detection and treatment

After obtaining the consent of all recruited participants, a rapid diagnostic test was performed. Capillary blood was obtained *via* finger stick for malaria testing using RDT SD BIOLINE Malaria Ag Pf/Pan test (Abbott, US). In different visited households, malaria infection was diagnosed only in children ≤ 5 years of age and women aged 15-49 years. Test results were recorded on a patient sheet and data on symptoms were also collected. Participants with positive RDT results were offered immediate treatment with either artemether-lumefantrine for children and pregnant women in their second or third trimester Coartem[®], child: 20 mg / 120 mg and adult: 80mg / 480 mg (Novartis, Switzerland), or quinine for pregnant women in their first trimester Surquina 250 mg (Innothera chouzy, France), according to national treatment guidelines.

Data analysis

Statistical analyses were carried out with Epi-info version 3.5.3 (2005, CDC, Atlanta, USA) and STATA version 14 (Stata Corp, College Station, USA). Age was expressed as the mean and standard deviation. The age variable was transformed into a categorical variable with six class: 15 to 20 years, 21 to 25 years, 26 to 30 years, 31 to 35 years, 36 to 40 years and 41 to 49 years. The Chi-square test was used to compare categorical variables. Values of $p < 0.05$ were considered to indicate a statistically significant difference.

Results

A total of 1,307 participants were recruited in this study, originating from 535 homes. Included in the study were 631 women of childbearing age, including sixty-one (61) pregnant women, and 676 children. Data were available only for 1296 participants. The pregnancy status and the number of months of pregnancy of the women was self-reported and no confirmatory pregnancy tests were carried out.

Clinical and socio-demographic characteristics of the studied population

All participants were residents of the Nyanga Province. The mean age of interviewed women was 334.05 ± 129.54 months.

On average, there were 7.45 ± 3.50 people per household, including 1.95 ± 1.34 children and 0.17 ± 0.43 pregnant women with an average of 5.51 ± 2.58 months of pregnancy. About 162 out of 1299 (12.5%) were febrile (axillary temperature > 37.5 °C) and 7.5% (97/1296) had history of fever in the last 14 days prior to sampling. The general description of participants is shown in Table 1.

General knowledge on malaria causes, symptoms and prevention

Almost the entire interviewed population previously heard about malaria (97.7%) and attributed the cause of malaria to a mosquito bite (95.7%, 617/649). The majority of the respondents (96.2%, (624/649) also thought that they could get malaria by walking in the rain. Some respondents (17.3%, (112/649) believed malaria to be transmitted by ingesting of dirty water, and finally, (8.3% (54/649) of the studied population thought that malaria was transmitted sexually. The most commonly known clinical symptoms by the respondents were, fever (88.7%), body aches (78.3%), headache (74.1%), fatigue (71.3%), vomiting (49.69%), cough (21.9%), diarrhea (20.1%), and stomachaches (19.8%)

Knowledge and action for malaria prevention and vector control were also evaluated. The majority of the interviewed individuals thought that the use of bed nets at home and environmental sanitation (95.06% and 84.57%, respectively) could prevent malaria. More than half of the respondents thought that spraying insecticides could also prevent malaria (64.7%). Less than half of the respondents thought that vaccination and washing their hands before eating (64.5% and 49.9%, respectively) could also be ways to prevent malaria.

Information source

The interviewed people who had already heard of malaria reported receiving information on malaria from one or more sources. The sources of information were varied and are reported in Table 2. Among the different sources of information, the largest proportion of

respondents had received information regarding malaria from a media source (67.7%), followed by hospitals, health center or doctors (22.9%). The sources least reported were schools and sensitization campaigns (2.6%). Among media sources television and social media were a major source of malaria information for all respondents.

Table 2: Sources of information regarding malaria among respondents who had received information about malaria.

Preventive measures

This survey revealed that the bed-net coverage rate was 73.3% (924/1260). Insecticide spraying was used by 52.1% (574/1103) of the subjects. Fans were more commonly used according to this study than air-conditioners (58.4%, n/N, versus 3.2%, n/N, $p < 0.05$). More than half of the women had not received an Insecticide-Treated bed Nets (ITN) during antenatal visits of their last pregnancy. Sixty-six percent (66.1%) of women said that Long Lasting Insecticide Nets (LLIN) is free in public health facilities, but 26.1% reported that it was not free. As for intermittent preventive treatment with Sulfadoxine-Pyrimethamine (IPT-SP), 50.2% of women said that IPT-SP is free in public health facilities, whereas 32.6% of them stated it was not.

Characteristics of plasmodial infection

The overall prevalence of plasmodial infection diagnosed with RDT was 13.9% (180/1296). It was significantly different between department capitals ($p < 0.05$). The prevalence of *Plasmodium* infection was higher in Tchibanga [18.7% (145/776)] compared to Moulingui-Binza [9.2% (8/87)], ($p = 0.02$) and Mabanda [3.6% (3/83)], ($p = 0.0005$). In Moabi, the prevalence of plasmodial infection [14.8% (24/162)] was higher than in Mabanda [3.6% (3/83)], ($p = 0.008$). There was no plasmodial infection diagnosis in Mayumba. The overall

prevalence of plasmodial infection was 16.5% (111/674) in children \leq 5 years old, 10.2% (57/558) in women of childbearing age, and 20.0% (12/60) in pregnant women. The difference in prevalence of plasmodial infection between children, adults, and pregnant women was significant in the surveyed sites ($p = 0.01$). The prevalence of plasmodial infection between these same groups was also significantly different in Tchibanga and Moabi ($p = 0.007$, $p = 0.006$, respectively). In addition, the prevalence of infection was significantly different between age groups in women of childbearing age. Women between 11 to 20 years of age (37.50%) were more infected than other women in other age groups ($p=0.012$). Table 2 and Figure 2 show a summary of the general characterization of the plasmodial infection by department capitals. There was no significant difference between the number of infected individuals sleeping under mosquito nets and using insecticides and the ones that are uninfected and do not sleep under a net and do not use insecticides ($p > 0.05$) as shown in Figure 3.

Discussion

This study provides the first data on the epidemiological parameters, characteristics of plasmodial infection, and the knowledge and prevention practices regarding malaria in a vulnerable population of the Nyanga province in Gabon.

In this cross-sectional survey, 1,307 individuals composed of women of childbearing age and children under 5 years old were included.

The vast majority of respondents (97.7%) in Nyanga province (rural area) were aware of malaria. Similar results have been reported in other studies in other countries [8-11].

In our study, we showed that our study population had adequate knowledge regarding the mosquito bite as the means of transmission. However, a large proportion of respondents also falsely thinks that walking under the rain is another cause of malaria. This finding was confirmed by the results of one of our other studies (unpublished data). The questionnaire may have failed to capture causes other than the four indicated. Our results also demonstrate that fever, and headache, fatigue and aches were correctly identified as symptoms of malaria which corroborates results from similar studies conducted in Cameroon, Ethiopia and Tanzania [8, 9, 12] where respondents were able to name at least one symptom of malaria.

National malaria programs need to know how and where their populations obtain information regarding malaria in order to better plan their communication activities. Our study revealed that most of the

population obtains information on malaria from media source and, to a lesser extent, from hospitals and health centers. Given the young mean age of the interviewed women (28 ±10.8 years), these results are to be expected as, in Gabon, the majority of young people watch television and are connected to social media via the internet. These findings are different from those obtained in another study led in India [13] in which overall, hospitals, health centers or doctors were the most frequently cited interpersonal source of information about malaria. This disparity could be explained by the difference in age of the women included in the different studies. However, the low prevalence of sensitization campaigns could be somewhat misleading as such campaigns used a variety of communication channels (i.e., medias sources, communication in school..) among others. It is thus possible that the respondents heard about malaria through these sources without necessarily associating them with the campaigns. These results also highlight the need for public health professionals to work together with media, as well as hospital facilities to disseminate accurate and reliable malaria information and use age-appropriate means of communication in order to have the most impact.

Respondents showed adequate knowledge in regards to bed nets, spraying of insecticides and environmental sanitation as effective prevention strategies. Over 95% of people interviewed in Nyanga Province reported using bed nets to prevent malaria. Indeed, in Gabon and in other countries of Central Africa, the national policy strategies against malaria relies on the use of Insecticide-treated bed nets. During this last decade, a concerted campaign against malaria has led to unprecedented levels of interventions across sub-Saharan Africa [14]. African governments and decision-makers in the health sector are in the habit of conducting mass awareness campaign promotion through audiovisual networks, social networks and newspapers. School age children usually are educated about malaria in school. Although these campaigns take place throughout the year, they are more emphasized during the internationally celebrated malaria awareness day. Also in Gabon, as other Malaria endemic countries, insecticide-treated bed nets are freely distributed to pregnant women and children under 5 years, as is intermittent preventive treatment for pregnant women, Indoor residual spraying is also now being widely used across Africa with increasing amounts of coverage achieved [5, 15]. Our results on measures of prevention are similar to those obtained in a recent study led in Cameroon and in Gabon [11, 16].

Not surprisingly our study showed a lower malaria prevalence from children under five years of age or less and women aged 15-49 years (13.6%) than that found in previous studies in other rural areas (Makokou 53.6%, Lastoursville 79.5%, Oyem 44.2 %) [6, 17]. This difference could be due to the fact that we targeted children ≤5 years old and women aged 15 to 49 years old in the general population who were mostly asymptomatic, whereas in other studies, the population tested was based in hospitals for some febrile patients and involved mostly children. Our low prevalence of malaria infection could also be associated with the high level of knowledge of preventive measures in our study area. [18]. The distribution of the malaria prevalence among the five departmental capitals of the Nyanga province was quite varied. The departmental capitals of Tchibanga and Moabi had a prevalence of 18.7% and 14.8% respectively, the highest prevalence for malaria parasite. Departmental capitals of Moulengui-Binza and Mabanda both showed parasite prevalence lower than 10% while in departmental capitals of Mayumba, malaria parasite was not at all detected. This variation between departmental capitals could be explained

by some factors such as the population density. In fact, Tchibanga, which is the main town of the Nyanga province comprises more than half of the total population in that geographical area. It was surprising that none of 188 participants that were tested in Mayumba were positive for malaria infection since Gabon is hyperendemic for malaria.

The data revealed no relationship between preventive measures (ITNs and insecticides) and malaria prevalence in the study sites, perhaps because overall net use was very high, as assumed in another of our studies [19].

Conclusion

High malaria prevalence is found in the departmental capital cities Nyanga province. This study reveals that respondents have a high knowledge of mode of transmission, malaria symptoms and preventive measures for the disease. Despite this high level of knowledge of the disease and its preventive measures, the incidence of malaria remains relatively high in this rural community highlighting the need for other types of interventions such as vector control and promote access to malaria screening and treatment

List Of Abbreviations

WHO (World Health Organization), ACT (Artemisinin-based Combination Therapy), RDT (Rapid Diagnostic Test), ITN (insecticide-treated bed nets), LLN (long-lasting insecticide-treated nets), NGO (Non-Governmental Organization), MCDI (Medical Care Development International), CIRMF (*Centre International de Recherches Médicales de Franceville*)

Declarations

Ethics approval and consent to participate

The study was approved by the Gabonese National Ethics Committee (N°001/PR/SG/CNE/2018).

Consent for publication

No applicable

Availability of data and materials

No applicable

Competing interests

The authors have no competing of interests to report.

Funding

This work was supported by Noble Energy Gabon Ltd. and Woodside Energy (Gabon) Pty Ltd, through the Improved Integrated Maternal and Neonatal Survival Malaria and HIV/AIDS Prevention project, financed with the Gabonese Ministry of Petroleum and Hydrocarbon's' Local Community Development Fund, and implemented by Medical Care Development International from 2017-2019

Authors' contributions

JBLD, JNDC and JB participated in the conception and design of the study. JBLD, RKIL, SKN and MNS participated in the interpretation of results, drafting and revision of the manuscript. JBLD, RKIL, MNS, NPTT, PNSOE, AMO and APO contributed to the acquisition of data in the field. JBLD is the guarantor of this paper. All authors read and approved the final manuscript.

Acknowledgements

The authors would like to acknowledge the MCDI (Medical Care Development International, European and Developing Countries Clinical Trials Partnership) and the CIRMF (*Centre International de Recherches Médicales de Franceville*). All the authors sincerely thank all the women and their children included in this study. We acknowledge Mrs Heidi Lançon for the English revision of the manuscript.

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Tables

Table 1: Socio-demographic characteristics of study population

| <i>Variables</i> | <i>Cities (% ; n/N)</i> | | | | | <i>Total</i> |
|-------------------------------|-------------------------|--------------------|--------------------|-----------------------------|--------------------|--------------|
| | <i>Mabanda</i> | <i>Mayumba</i> | <i>Moabi</i> | <i>Moulingui- Binza</i> | <i>Tchibanga</i> | |
| <i>ories</i> | | | | | | |
| en (≤ 5 years) | 46.2% (42/91) | 60.6% (114/188) | 53.7% (87/162) | 57.5% (50/87) | 49.2% (383/779) | 676 |
| n of earing (15-49 | 53.9% (49/91) | 33.5% (63/188) | 40.1% (65/162) | 39.1% (34/87) | 46.1% (359/779) | 570 |
| ant women (15- rs) | 0.0% (0/91) | 5.9% (11/188) | 6.2% (10/162) | 3.5% (3/87) | 0.4% (37/779) | 61 |
| age \pm SD) | 16,8 \pm 15,2 | 15,6 \pm 14,7 | 15,7 \pm 13,7 | 15,1 \pm 15,8 | 16,0 \pm 14,7 | |
| <i>on occupation (20)</i> | | | | | | |
| nt | 9.5% (4/42) | 1.4% (1/72) | 36.0% (27/75) | 16.2% (6/37) | 20.8% (82/394) | 120 |
| er | 38.1% (16/42) | 30.5% (22/72) | 33.3% (25/75) | 48.7% (18/37) | 23.4% (92/394) | 173 |
| ess | 52.4% (22/42) | 68.1% (49/72) | 30.7% (23/75) | 35.1% (13/37) | 55.8% (220/394) | 327 |

[Please see the supplementary files section to view table 2.]

Table 3: Comparison between infected and uninfected women of childbearing age

| | <i>Cities (% ; n/N)</i> | | | | | Total |
|---|-------------------------|-----------------|-------------------|------------------------|--------------------|--------------|
| | Mabanda | Mayumba | Moabi | Moulingui-Binza | Tchibanga | |
| <i>demographics</i> | | | | | | |
| Positive RDT (%) | 3.6% (3/83) | 0.0% (0/188) | 14.8% (24/162) | 9.2% (8/87) | 18.7% (145/776) | 180 |
| Mean age ± SD (years) | 16.8 ± 15.2 | 1.6 ± 14.7 | 15.7 ± 13.1 | 15.1 ± 15.8 | 16.0 ± 14.7 | |
| <i>Health status</i> | | | | | | |
| Children (≤5 years) | 4.9% (2/41) | 0.0% (0/114) | 23.0% (20/87) | 12.0% (6/50) | 21.7% (83/382) | 111 |
| Women of childbearing age (15-49 years) | 2.4% (1/42) | 0.0% (0/63) | 6.2% (4/65) | 2.9% (1/34) | 14.4% (51/354) | 57 |
| Pregnant women (15-49 years) | --- | 0.0% (0/11) | 0.0% (0/10) | 33.3% (1/3) | 30.6% (11/36) | 12 |
| <i>Men occupation (N= 68)</i> | | | | | | |
| Employed | --- | --- | 50.0% (2/4) | 50.0% (1/2) | 19.7% (12/61) | 15 |
| Unemployed | --- | --- | 25.0% (1/4) | --- | 19.7% (12/61) | 13 |
| Homeless | 100% (1/1) | --- | 25.0% (1/4) | 50.0% (1/2) | 60.7% (37/61) | 40 |

Figures

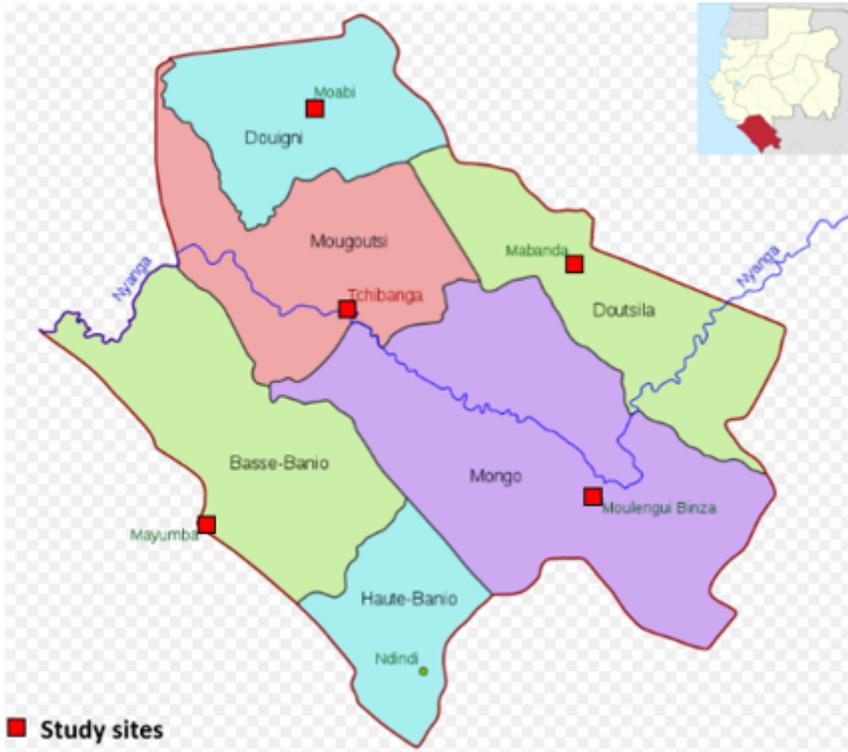


Figure 1

Study sites.

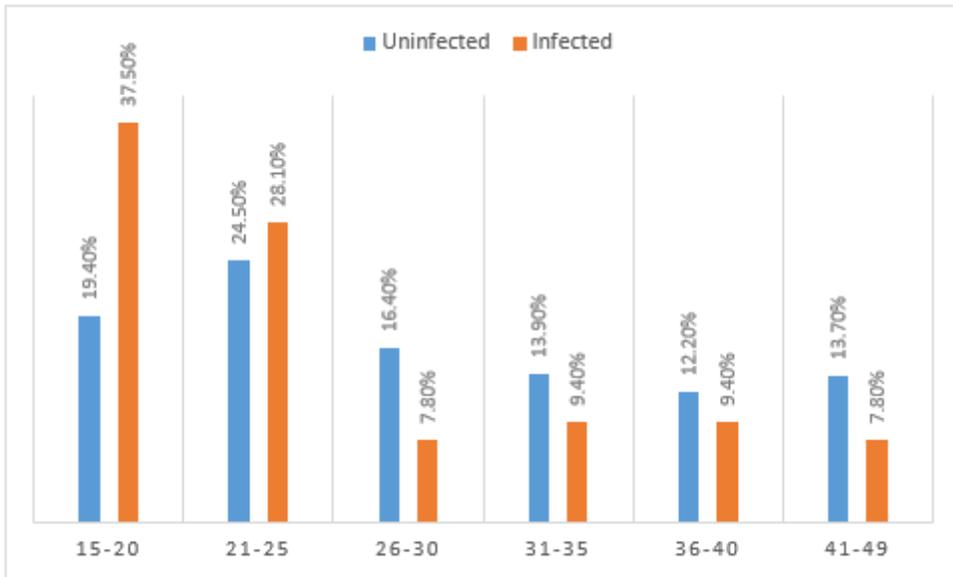


Figure 2

Proportions of infected and uninfected women of childbearing age

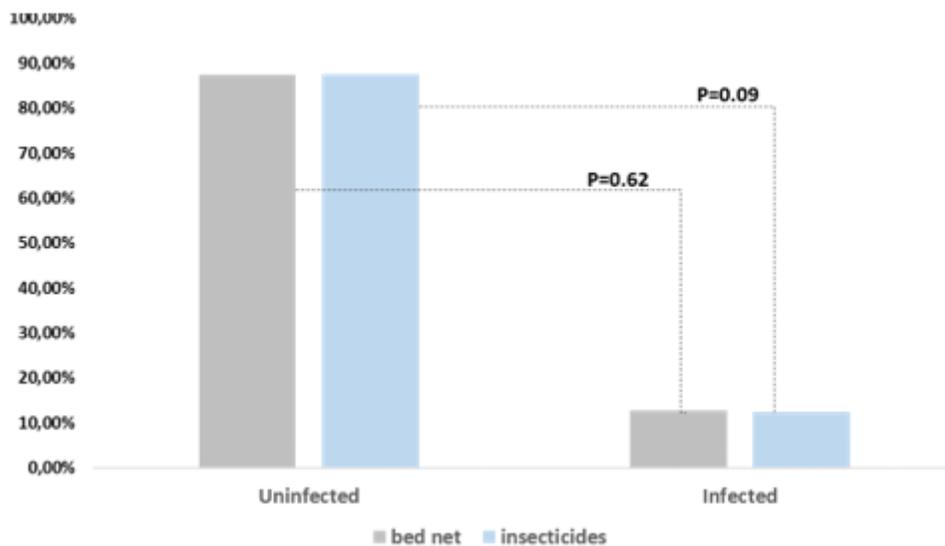


Figure 3

Proportions of interviewed study participants sleeping under a bednet and using insecticides, among those testing positive by a malaria RDT (infected) versus testing negative (uninfected).

Supplementary Files

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

- [Questionnaire.docx](#)
- [Table2.docx](#)