



Malaria prevention practices among patients attending the NTOUM departmental hospital, Northwest Gabon

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Abstract

Introduction: In Gabon, a territory located in Central Africa, prevention is an essential measure in the fight against malaria. The aim of this study was to evaluate, in the Komo-Mondah department, the prophylaxis practices employed by the inhabitants of the commune of Ntoum and the prevalence of anti-malarial drugs prescribed by local doctors. **Methods:** We carried out a prospective, cross-sectional study over a 3-month period, on patients of both sexes and of all ages who came for consultation to the departmental hospital of Ntoum. Patients who had a prescription for malaria drugs at the end of their medical visit were included in the study. **Results:** Of the 248 subjects enrolled, children under 5 years of age were the main victims (84%). Indeed, children under 5 were two (2) and three (3) times more likely to test positive to malaria than the age group 16-24 (OR = 2.44 [1.05 - 5.63]; P < 0.05), 25 and over (OR= 3.10 [1.46 - 6.59]; P < 0.05), respectively. Anti-malaria prophylaxis was practiced by 80% of the study population. Patients who declared sleeping under a bed net appear to be protected compare to those who did not (OR= 0.53 [0.28 - 0.97] ; P < 0.05). Self-medication was recorded in 29% of patients, and the drugs most commonly prescribed by doctors were artemisinin-based combinations, including Artefan (51%), Coartem (30%) and Eurartesim (2%). **Conclusion:** Although conventional prophylaxis measures (vector control and chemoprevention) are adopted by many Gabonese, careful pharmacological management and the implementation of targeted, long-term prevention-surveillance and health education strategies will enable effective malaria control in this part of Gabon.

Keywords: Prophylaxis; Malaria; Ntoum; Komo-Mondah; Estuaire

1. Introduction

Malaria is an infectious disease caused by a blood-borne parasite of the genus *Plasmodium*. Human infection begins when an infected *Anopheles* mosquito, during its blood meal, inoculates the parasite in the form of sporozoites contained in its salivary glands. [1]. After the asexual erythrocytic cycle, or erythrocytic schizogony, the infected host experiences fever, headaches, chills or convulsions of varying severity, which can lead to death if untreated or inadequately treated. [2]. Although various methods of combating this disease have been adopted in recent years in several African countries, such as the distribution of insecticide-treated mosquito nets and the use of artemisinin-based combination therapy (ACT), the number of deaths associated with malaria is constantly rising [3]. WHO estimates that 95% of cases and 96% of deaths are recorded in Africa, making this continent the region of the world most affected by the disease [4]. In Gabon, a country in Central Africa, the equatorial climate is highly conducive to the development and hatching of *Anopheles* mosquito larvae [5], making the country hyper-endemic for malaria [6]. Worldwide, five species of *Plasmodium* infect humans (*P. falciparum*, *P. malariae*, *P. ovale*, *P. vivax* and *P. knowlesi*). The deadliest of all is *P.*

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falciparum, found mainly in Gabon [7]. To combat malaria in this equatorial country, many people resort to prophylactic methods. These include the use of mosquito nets or insecticides to prevent contact between mosquitoes and humans, and chemoprevention to slow down the development of Plasmodium or eliminate it permanently from the infected organism [8]. For several years, numerous epidemiological studies on infant health [9, 10], maternal-fetal health [11, 12], prophylaxis [8] and pharmacoresistance to certain antimalarial drugs [13,14,15] have been carried out in various departments of Gabon. To the best of our knowledge, no malaria related studies have been undertaken in the Komo-Mondah department. To solve this problem, the present observational study aimed to describe in the commune of Ntoun: the prophylaxis practices applied by the population, and the drug prescriptions issued by doctors to patients suffering from malaria.

2. Material and methods

2.1. Study type, setting and location.

This was a descriptive observational study conducted from August 18 to October 18, 2023. The study took place at the departmental hospital in Ntoun, the region's main health facility. Ntoun, 38 kilometers (km) from the country's administrative capital, is the capital of the Komo-Mondah department in the Estuary province (figure 1). Gabon's Komo-Mondah is characterized by very high rainfall (2,000 to 3,800 mm) and a large number of rainy days (170 to 200). Temperatures remain high throughout the year, and sunshine levels are among the highest in the country [16]. Since the rehabilitation of the national road #1, the city has experienced a significant demographic expansion (population estimated at 90,096 in 2013) and urban growth (48.9 inhabitants/km²). The city offers a suitable living environment thanks to the availability of essential public services. The municipality is spatially extensive, with dwellings surrounded by secondary forests, mangroves, freshwater and saltwater swamps, grassy ponds, rivers and streams that are ideal for the development of Anopheles mosquito larvae. This proximity of the population to wild flora exposes its members to frequent contact with the wild fauna it shelters, sometimes inducing infectious diseases in the latter.

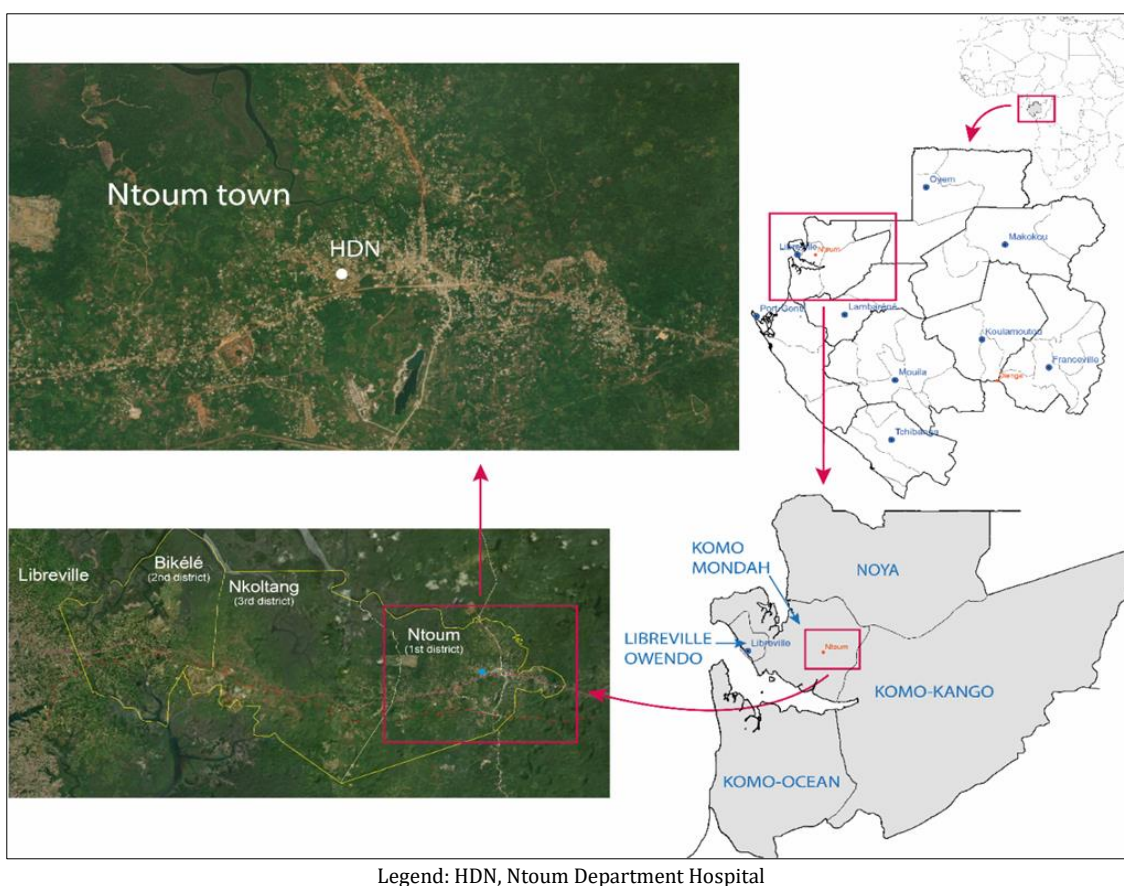


Figure 1 Geographical location of the study site

2.2. Study population, inclusion criteria

Patients of both sexes and all ages were enrolled in the consultation room. Patients who had been clinically and biologically diagnosed as having malaria and who had a prescription for antimalarial drugs at the end of their medical visit were included in the study.

2.3. Sample size

The exhaustive cohort size was determined according to the following formula: $(n = z^2 pq / i^2)$ where: "n" represents the minimum number of patients to be enrolled; "z" the critical value following the reduced centered normal distribution worth 1.96 for a risk of error α ($\alpha=5\%$); "p", the national prevalence of malaria (16% in the Gabonese republic) [4]; "q" worth $1-p= 0.84$; "i", the degree of precision ($i=0.05$).⁵ In order to have a direct impact on the accuracy of the statistics produced, the minimum size of the cohort was determined using Daniel Schwartz's formula, which was 207 patients. However, in order to guarantee greater precision and excellent statistical power, 41 additional patients or 20% of the cohort were added, bringing the final number of patients to 248.

2.4. Data collection and statistical analysis

Patients who met the inclusion criteria and consented to participate in the study were interviewed by a nurse. For adult patients, the nurse carefully filled in the pre-established data collection form, specifying socio-demographic characteristics, malaria prevention and automedication behaviors. For minors, an oral consent was sought and obtained from the legal guardian.

Collected data were enter into Excel spread sheets and analyzed using MedCalc® Statistical Software version 20.027 (MedCalc Software Ltd. Ostend. Belgium; <https://www.medcalc.org>; 2022). Sociodemographic characteristics of participants were described using descriptive statistics. ODDS ratio and Pearson's Chi square test were used to determine the degree of association between malaria and independent variables. A P-value ≤ 0.05 was considered statistically significant.

2.5. Ethical considerations

All patients who signed an inform consent were included in the study. Participants' identities were kept secret and permission was obtained from the internal review board of NTOUM Departmental Hospital. The protocol of the study was conducted in agreement with the ethics rules of the Declaration of Helsinki.

3. Results

3.1. Socio-demographic characteristics and malaria prevention behaviors of patients attending the NTOUM Departmental Hospital, Northwest Gabon.

A total of 248 patients (152 female and 96 male) were included in the study (Table 1). The mean age of participants was 17.40 ± 1.19 with an age ranging from zero to 78. Children under 5 were the most represented group with 38.71% followed by adults age 25 and older (25.40%). The vast majority of participants (93.55%) resided in Ntoum and over 67% had secondary school education. Among all patients, 115 (46.37) declared sleeping under an insecticide-treated bed net, 113 (45.56) using insecticide sprays, and 71 (28.63) practicing automedication. The interviews also revealed that two third (2/3) of participants were students and unemployed.

Table 1 Socio-demographic characteristics, malaria prevention behaviors and infection status of patients attending the NTOUM Departmental Hospital, Northwest Gabon

Variable	Frequency (%)	Malaria + (%)	O.R.	95% CI	P-value
Gender					
Female	152 (61.30)	117 (77)			
Male	96 (38.70)	73 (76)	1.05	0.57 - 1.92	0.86
Age					
0-5	96 (38.71)	81 (84.40)	Ref		
6-15	44 (17.74)	38 (86.40)	0.85	0.30 - 2.36	0.759

16-24	45 (18.15)	31 (68.90)	2.44	1.05 - 5.63	0.037
≥25	63 (25.40)	40 (63.50)	3.10	1.46 - 6.59	0.003
Education level					
Primary	24 (9.7)	17 (70.83)	1.51	0.58 - 3.92	0.39
Secondary	168 (67.7)	132 (78.57)	Ref		
University	56 (22.6)	41 (73.21)	1.34	0.67 - 2.69	0.41
Occupation					
Student	82 (33.06)	63 (76.83)	0.83	0.37 - 1.88	0.66
Unemployed	82 (33.06)	65 (79.27)	0.72	0.31 - 1.65	0.44
Formal	39 (15.73)	26 (66.66)	0.96	0.35 - 2.57	0.93
Informal	45 (18.15)	36 (80)	Ref		
Place of Residence					
Ntoum	232 (93.55)	177 (76.30)	1.86	0.22 - 15.82	0.56
Kango	9 (3.63)	7 (77.77)	1.71	0.123 - 23.94	0.68
Libreville	7 (2.82)	6 (85.71)	Ref		
Use of ITN					
Yes	115 (46.37)	95 (82.61)	0.53	0.28 - 0.97	0.04
No	133 (53.63)	95 (75.43)	Ref		
Use of Insecticide Spray					
Yes	113 (45.56)	84 (74.33)	1.26		
No	135 (54.44)	106 (78.52)	Ref	0.70 - 2.27	0.43
Practice of Automedication					
Yes	71 (28.63)	59 (83.10)	Ref		
No	177 (73.37)	131 (74.01)	0.9417	0.52 - 1.70	0.84

Ref: reference

3.2. Antimalarial prophylaxis.

The results of table 1 revealed that patients who declared sleeping under a bed net were 47 % more protected than those who did not, and the difference was found significant (OR= 0.53 [0.28 - 0.97] ; P < 0.05).

Likewise, patients aged 16-24, and over 25, were respectively over two (2) and three (3) times less prone to test positive to malaria than children under 5 and the differences were statistically significant (OR = 2.44 [1.05 - 5.63]; OR= 3.10 [1.46 - 6.59]; P < 0.05). However, the gender, the education level, the occupation, the city of residence, the use of insecticide spray, and the automedication practice were not statistically associated with malaria (P > 0.05). It is noteworthy to mention that patients living in Ntoum and Kango, two semi-rural cities, were nearly two (2) times more likely to test positive to malaria compare to those living in the capital city Libreville. However, the statistical difference was not significant.

3.3. Drug prescriptions

The drugs used were mainly curative, with Artefan (Artemether/Lumefantrine), Coartem (Artemether and Lumefantrine), Malacur (combination of Artemisinin and derivatives) accounting for 51% (30/59), 30% (18/59), and 8% (5/59), respectively. The remaining preventive (Combimal, Maloxine [Sulfadoxine, Pyrimethamine]) and curative (Artesiane, Artesunate, Eurartesim) antiparasitics each accounted for 2% (1/59) of self-medication. Curam (1/59), an antibiotic whose active molecule is amoxicillin/clavulanic acid (Figure 2), was used to a surprising extent. Lumefantrine

followed by dihydroartemisinin-piperaquine are the most representative molecules, accounting for 81% and 10% respectively (Figure 3).

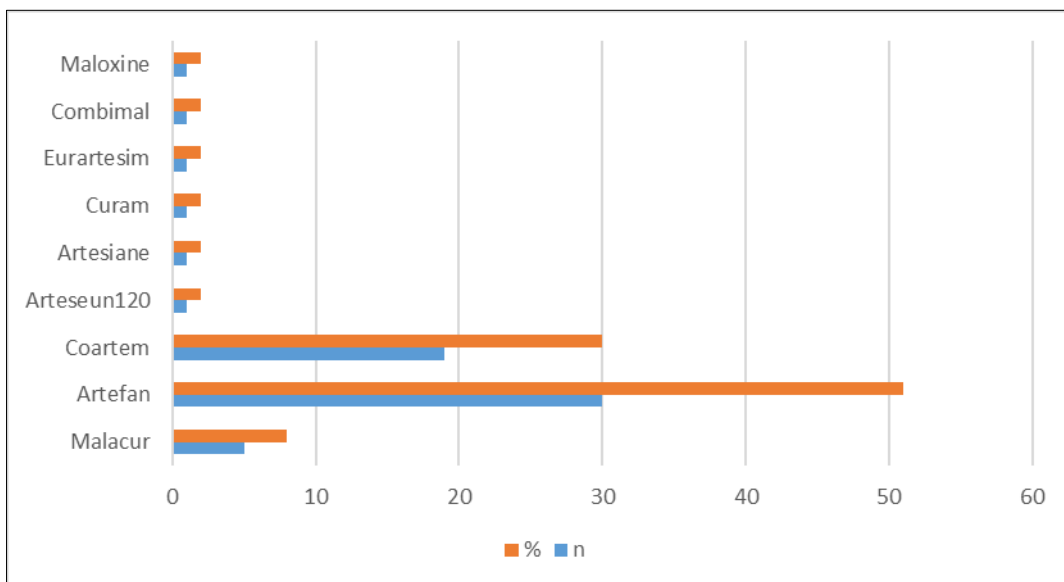


Figure 2 Drugs used

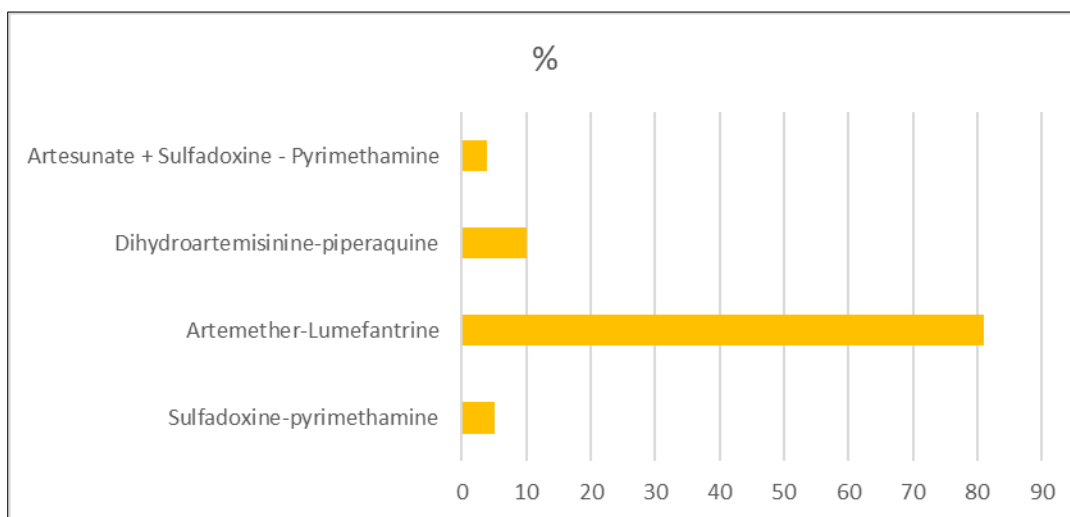


Figure 3 Most representative molecules

4. Discussion

The results of this study provide a detailed view of the epidemiological characteristics, symptomatology, and preventive and curative prophylaxis practices employed by malaria patients in the commune of Ntoum, a semi-rural town in the province of Gabon.

4.1. Malaria prophylaxis.

Malaria prophylaxis measures vary considerably within the study population. The diversity of practices highlights the complexity of preventive behaviors.

Patients who report sleeping under a bed appear to be protected from malaria, which is consistent with studies that have reported the protective effect of insecticide-treated bednets in pregnant women in Cameroon and in children

under 5 in Benin [21, 22]. The 16-24 and under-5 age groups were the most affected, with prevalences of 86.4% and 84.4% respectively. These results are in agreement with two studies carried out in southeastern Gabon, which reported prevalences of 71.8% (479/667) in 2023 and 77.28% (2381/3081) in 2021 for children under 5 years of age [23] and patients over 18 years of age [24] respectively; the trend was lower in our cohort (46.37%, 115/248).

Self-medication is a common practice in sub-Saharan Africa [25], with 25, 42 and 62% of patients in Madagascar, Mali and Guinea Conakry reporting having resorted to this practice [26, 27, 28]. There were disparities between study areas in the Gabonese context: 41% in households in the semi-rural mining town of Moanda in Haut Ogooué province [8], 65% in the urban city of Libreville in Estuaire province [29] and 29% in our study.

The average use of insecticides (46%) and ITNs (47%), and the very low level of self-medication (29%), indicate the absolute need to intensify awareness-raising programs among the population of the town of Ntoum, despite the fact that they are alert to the warning symptoms.

4.2. Drug prescriptions

Prescribing patterns largely reflect the use of artemisinin-based/derivative antimalarials, in particular Artefan and Coartem, in line with national and WHO guidelines. Self-medication appears to be an initial strategy little practiced by the inhabitants of Ntoum; however, in view of the diversity of antiparasitics used, and moreover an antibiotic such as Curam, concerns about the efficacy of this approach emerge, while suggesting the need to closely monitor the potential emergence of resistance to these antiparasitics/antibiotics.

5. Conclusion

This study has provided crucial information in understanding the malaria prevention practices observed by the population in the region of Ntoum. The results underline the importance and necessity of carrying out targeted, long-term preventive-health education campaigns in the Komo-Mondah department, and of maintaining constant epidemiological surveillance in order to reduce the malaria burden and thus effectively combat the disease.

In the future, it would be welcome to investigate the proportion of parasites resistant to insecticides and antimalarial molecules. Educational and regulatory measures are desirable to control the phenomenon of self-medication, which nevertheless remains individually inappropriate and collectively dangerous

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

All prospective participants who signed an informed consent were included in the study. Participants' identities were kept secret and permission was obtained from the hospital internal review board. The study protocol was conducted in line with ethics rules contained in the Declaration of Helsinki.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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