Carrying Asymptomatic Malaria In Ouéllé Locality, And Surrounding Villages, In Southeastern Gabon: An Epidemiological Analysis, In Rural Central Africa

Anouscka M. Nzamba[1], Capucine Favret [2], Gaelvy Tendresse Bobey Ngoulou [2], Thiéry Ndong Mba[3,4]

[1]" Tahiba " Nursing and Health Promotion Practice (Franceville, Gabon)
[2]SUCAF Foundation -Gabon

[3]Laboratory of Molecular and Cellular Biology (USTM) Franceville, Gabon

[4]Biochemestry Research Laboratory (BIORL), Masuku Sciences et Technonlogy University (USTM) Franceville, Gabon
e-mail: tndongmba2021@gmail.com

Abstract

Background: Malaria remains a major public health problem in sub-Saharan Africa, and particularly in Gabon. In an epidemiological analysis in a rural area, the present study assessed asymptomatic malaria carriage in Ouéllé, and surrounding villages, in South-eastern Gabon: an epidemiological analysis, in a rural area of central Africa.

Patients and method: This prospective, cross-sectional study was conducted from June 26 to 28, 2023. The sociodemographic characteristics of the participants were obtained. A small portion of blood collected by finger prick from each participant was used for qualitative detection of malaria-causing Plasmodium infection, using a Malaria Test MeriScreenTM Pf/PAN Ag lateral flow immunochromatographic assay. Results of analysis by R software version 4.0.3, were considered significant at p≤0.05.

Results: Of the 321 people registered for the present study, 97 (30.22%) (95% CI: 0.25 - 0.36) (n=97), tested positive for malaria, compared with 224 (69.78%) ((95% CI: 0.64 - 0.75) (n=224). While a univariate analysis of the prevalence of malaria carriage according to gender showed no statistically significant association between the variables p=0.56, a univariate analysis of the prevalence of malaria carriage according to age group indicated that only participants aged between 28 and 57 (OR =0.17; 95% CI: [0.04 - 0.73] p=0. 007*), and according to each locality, the analysis showed that participants from Mvengué (OR =0.17; CI 95% : [0.04 - 0.73] p=0.007*), Djoutou (OR =0.17; CI 95% : [0.04 - 0.73] p=0. 007*), and Mouyabi (OR =0.17; 95% CI: [0.04 - 0.73] p=0.007*), were statistically susceptible to malaria were significantly associated with malaria carriage in the present study.

Conclusion: These results, which indicate the persistence of asymptomatic malaria in Ouéllé and surrounding villages, call on Gabon's health authorities to redouble their efforts to combat malaria throughout the country.

Keywords – Carriage; asymptomatic malaria; Ouélé; Haut-Ogooué; Gabon.

I. INTRODUCTION

In 2021, the number of malaria cases has been estimated at 247 million in 84 malaria-endemic countries (including the territory of French Guyana), up from 245 million in 2020. Most of the additional cases are estimated to be in the WHO African region [1], and the increase in these figures each year is proper to the deterioration of health systems, increased resistance to drugs and insecticides, climate change and war [2]. Malaria remains one of the main causes of morbidity in developing countries. High-risk groups include children (especially under-fives), pregnant women, travellers, displaced persons and workers arriving in endemic

---

Corresponding Author: Thiéry Ndong Mba

areas [3]. Of the 1.5 to 2.7 million people killed by malaria each year worldwide, children aged 0 to 5 pay the highest price, every 30 seconds or 3,000 children a day [4]. Globally, malaria is one of the most acute, severe and persistent health problems in Africa. The annual loss of gross domestic product due to this disease is estimated at over 12 billion [5]. The infection rate remains the highest in sub-Saharan Africa, where malaria is the leading cause of death in children under five [6]. Malaria is a major public health problem in Gabon. It is one of the main causes of consultation or hospitalization in health facilities, and can lead to death throughout the country [7]. The extreme poverty of the population, insalubrity in urban and rural areas, and the widespread practice of self-medication are at the root of the high prevalence of this endemic in Gabon, where the disease is endemic and transmission is quasi-permanent [8]. Despite the existence of some studies in other regions of the country, it is clear that malaria remains the most common disease, and there is a lack of data in our study area. It is in this context that this study was carried out, to evaluate the Carrying of asymptomatic malaria in the locality of Ouéllé, and surrounding villages, in south-eastern Gabon: an epidemiological analysis, in a rural area of Central Africa.

II. MATERIALS AND METHODS

II.1 Type, area and study population

This cross-sectional, prospective study was carried out from June 26 to 28, 2023 in Ouéllé and surrounding villages, in south-eastern Gabon: an epidemiological analysis, in a rural area of Central Africa. Located on the Franceville-Moanda axis, these villages have a tropical climate, with two rainy seasons from September to November and from February to May, separated by two dry seasons. In addition to the presence of the SUCAF Gabon company, which operates sugarcane plantations in Ouéllé, the main activities of the local population are subsistence farming, game hunting, fishing and a few jobs in the local administrative sector. The vegetation is equatorial. Ouéllé has a secondary school, an elementary school and a medical center.

II.2 Study procedure

II.2.1. Inclusion and exclusion criteria,

Only people who had agreed to donate blood, and children whose parents or legal guardians had previously signed and freely consented to their participation, were included in this study. Individuals who refused to participate in the study were excluded.

II.2.2. Sampling method and sample size

To select examinees, a systematic, random and simple sampling technique was used, and the size of our study population was 321 participants, leading to an inclusion rate of 98.8%.

II.2.3. Questionnary

A structured, pre-established and pre-tested questionnaire was submitted to participants to collect socio-demographic characteristics (age, gender, area of residence).

II.2.4. Malaria diagnosis in the field

Using a capillary pipette (5 μl) supplied by the manufacturer, a tiny portion of the blood collected by finger prick was immediately used in the field to perform rapid malaria diagnostic tests. One Step test for Malaria Pf/Pan Ag MERISCREEN Malaria Pf/Pan Ag is an in vitro immunochromatographic test for the qualitative detection of infection by malaria-causing Plasmodium parasites that aids malaria diagnosis, by detecting specific antigens (proteins) produced by malaria parasites in the blood of an infected person. The rapid diagnostic test (RDT) used in this study was the MeriScreenTM Malaria Pf/PAN Ag test, which has a sensitivity and specificity of 95% and 99.5% (MeriScreenTM Malaria Ag P.f/Pan, Meril Diagnostics Pvt. Ltd). This test can detect *P. falciparum* and other plasmodia infecting humans (*Plasmodium ovale*, *Plasmodium vivax* and *Plasmodium malariae*).

Interpretation

The result was read 20 minutes after the addition of 4 drops of a "diluent" supplied in the kit according to the manufacturer's recommendations. The presence of a single-colored band (control line "C") in the results window indicated a negative result. When two colored bands ("P.f" test line and "C" control line) or three colored bands ("P.f", "Pan" test lines and "C" control line) appeared in the results window, depending on which band appeared first, the result was considered positive for P. falciparum or

for a mixed infection of P. falciparum, and P. vivax, P. malariae or P. ovale respectively. The test was considered positive even if the "P.f" and/or "Pan" bands were faint, and invalid if the control band (control line "C") was not visible in the results window after the test was run. All this was done in accordance with the manufacturer's recommendations.

II.3. Data quality assurance

In order to assess the validity and completeness of the data, a questionnaire was pre-tested with 5% of the study subjects prior to the actual data collection. This process was followed methodically and rigorously. To check the accuracy and completeness of the questionnaire data obtained from each study participant, the data were examined immediately. Samples were processed and tested by an experienced laboratory professional and in accordance with supplier and manufacturer recommendations. The sensitivity and specificity of the Malaria Test MeriScreenTM Pf/PAN Ag rapid test was 98%.

II.4. Ethical considerations

The study was authorized by the Regional Director of Health for South-East Gabon, in letter no. 0345/PHO/SG/DRSSE/SGP/D. Sampling was designed on the basis of voluntary participation of pregnant women in the study, after explaining the reasons, benefits and confidentiality of the study. Participation in the study was finalized by the written and formulated consent of each participant. Participation in the study was finalized by the formal written consent of each participant. To preserve anonymity, code numbers were used instead of nominal identifiers.

NB: Any participant found to be positive received a box of anti-malarial medication.

II.5. Statistical analysis of data

The data collected were entered into a Microsoft Excel 2013 spreadsheet, cleaned and then analyzed using R software version 4.0.3. To assess the association between the prevalence of asymptomatic malaria carriage and the age, sex and locality of participants, univariate analyses were performed. Crude odds ratios and their 95% confidence intervals were used to measure the strength of the association between variables. P-values were determined and considered significant when less than or equal to 0.05.

III. RESULTS

III.1 Sociodemographic characteristics of the study population

In the present study, a total of 321 asymptomatic individuals. With a mean age of 11.26 ±11.06 years, and a sex ratio (M//F) of 0.66, 60.12% (n=193) of the subjects were female, compared with 39.88% (n=128) male. The age groups 4 months - 4 years and 5-15 years were in the majority, with 39.88% (n=128) and 39.25% (n=126) participants respectively. In the present study, 123 participants or 38.32% were from Ouelle. The surrounding villages had 109 participants or 33.96% from Mvengue, 55 participants or 17.13% from Djoutou and 34 participants or 10.59% from Mouyabi. Table1.

Table 1: Socio-demographic characteristics of the study population

Sociodemographic characteristics	participant Numbers	Percentage (%)
Age		
4 months – 4 years	128	39.88
5 – 15 years	126	39.25
16 – 27 years	29	9.04
28 – 57 years	27	8.41
58 and over	11	3.42

Gender		
Female	193	60.12
Male	128	39.88
Localities		
Ouélé SUCAF	123	38.32
Mvengué	109	33.96
Djoutou	55	17.13
Mouyabi	34	10.59

III.2 Prevalence of malaria carriage among study participants (n=321)

Of the 321 people registered for the present study, 97(30.22%) (95% CI: 0.25 - 0.36) (n=97), tested positive for malaria, compared with 224 (69.78%) (95% CI: 0.64 - 0.75) (n=224) Figure 1.
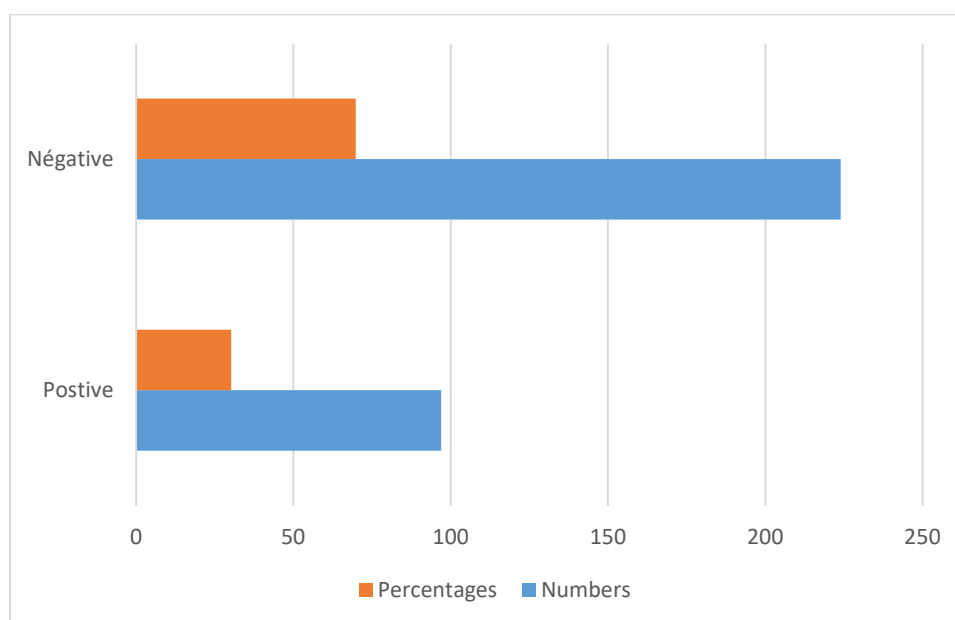
III.3. Prevalence of malaria carriage by sex among study participants (n=321)

A univariate analysis of the prevalence of malaria carriage according to sex showed no statistically significant association between the variables p=0.56 Table 2.

Table 2: Univariate analysis of malaria carriage by gender

Gender	Examined(%)	Malaria carriage prevalence		Univariate analysis Crude Odd Ratio 95% CI	p-value
		Positive (%)	Negative(%)		
Male	128 (39.86)	41 (32.03)	87 (67.97)	1.15 [0.71– 1.87]	0.56
Female	193 (60.12)	56 (29.02)	137 (70.98)	Reference	-

III.4. Prevalence of malaria carriage by age group among study participants (n=321)

A univariate analysis of the prevalence of malaria carriage by age group showed that only participants aged between 28 and 57 were statistically at risk of contracting malaria (OR =0).

Table 3: Prevalence of malaria carriage by age group

Age groups	Examined (%)	Malaria carriage prevalence		Univariate Crude odd Ratio 95% CI	p-value
		Positive (%)	Negative (%)		
4 months – 4 years	128 (39.86)	41 (32.03)	87 (67.97)	Reference	-
5 – 15 years	126 (39.25)	41 (32.54)	85 (67.46)	1.18 [0.73 – 1.92]	0.46
16 – 27 years	29 (9.04)	12 (41.38)	17(58,61)	1,68 [0.77 – 3.67]	0.19
28 – 57 years	27 (8.41)	2 (7.41)	25 (92.59)	0.17 [0.04 – 0.73]	**0.007***
58 – 85 years	11 (3.42)	1 (9.09)	10 (90.91)	0.22 [0.03 – 1.74]	0.12

*= Significant test

III.5. Prevalence of malaria carriage by locality of study participants (n=321)

A univariate analysis of malaria carriage prevalence by locality showed that participants from Mvengue (OR =0.17; 95% CI: [0.04 - 0.73] p=0.007*), Djoutou (OR =0. 17; 95% CI: [0.04 - 0.73] p=0.007*), and Mouyabi (OR =0.17; 95% CI: [0.04 - 0.73] p=0.007*), were significantly associated with malaria carriage in the present study. Table 4.

Table 4: Prevalence of malaria carriage by locality

Localities	Examined (%)	Malaria carriage prevalence		Univariate Crude odd Ratio 95% CI	p-value
		Positive (%)	Negative (%)		
Ouele SUCAF	123 (38.32)	41 (33.33)	82 (66.67)	Reference	-
Mvengue	109 (33.96)	43 (39.45)	63 (60.55)	2.03 [1.24 – 3.3]	**0.005***
Djoutou	55 (17.13)	9 (16.36)	47 (83.64)	0.39 [0.18 – 0.83]	**0.0011***
Mouyabi	34 (10.59)	2 (5.88)	32 (94.12)	0.13 [0,03 – 0.55]	**0.0010***

*= Test significatif

IV. DISCUSSION

With the general objective of assessing the prevalence of malaria carriage in the locality of Ouéllé and surrounding villages in south-eastern Gabon, the present study recorded and tested by rapid diagnostic test (RDT) a total of 321 people with an average age of 11.26 ±11.06 years. Of these, 97 (30.22%) were positive for malaria. This result, while higher than the 29% obtained elsewhere [9], was lower than the results obtained in two previous studies, one of which reported a malaria prevalence of 38.96% [10], and the other conducted in the Republic of Chad, which reported a prevalence of 36.57%. [11]. This variability of results can be justified not only by the geographical location of the study areas, but also by the disparity of the populations sampled. In addition, variations in national or local malaria transmission in different geographical contexts also have a bearing on the study periods. In addition, the disparity of diagnostic techniques used in each laboratory may also influence the results [12]. Contrary to an earlier study [13]. Although some studies have indicated that the prevalence of malaria in children is more predominant in boys than in women, and that this disparity may result from gender roles in the division of labor, hormonal factors or host genetics [14], a univariate analysis of the prevalence of malaria carriage according to gender in the present study showed no statistically significant association between the different variables. This could be explained by the fact that in endemic areas such as Gabon, the malaria parasite infects both men and women, despite differences in their sleeping behavior, use of mosquito nets and habitat characteristics [15]. . Consistent with the fact that age may be associated with malaria in general [16], a univariate analysis of malaria carriage prevalence by age group indicated that only participants aged between 28 and 57 were statistically susceptible to malaria. This result is contrary to that obtained in one study, which indicated that children aged 12 to 14 were 21% more malaria-infected [17]. This could be explained by the fact that, in areas of local malaria transmission, increasing age, which means repeated exposure to bites from infectious mosquitoes carrying malaria parasites, is positively associated with protective immunity against clinical signs of malaria [18]. Similarly, a study found that poverty, particularly in rural areas where poor-quality housing (holes in walls, openings in ceilings, surrounding vegetation and mosquito breeding sites) was a favorable environment for malaria [19], A univariate analysis of the prevalence of malaria carriage by locality showed that participants from the villages of Mvengué, Djoutou and Mouyabi were significantly associated with asymptomatic malaria carriage in the present study.

V. LIMITATIONS OF THE STUDY

Although this study provides relevant information, it has a number of limitations. Firstly, the collection of information did not focus on household risk factors such as the use of insecticide-treated bednets, which is one of the primary risk factors for malaria. Secondly, the unique use of the rapid diagnostic test (RDT) to estimate the prevalence of malaria carriage could provide false positives and negatives, which could have an impact on the prevalence obtained in the present study. The latter should benefit from well-integrated quality control procedures assessing the potential impact of reduced sensitivity and specificity, as has been done previously [20]. Furthermore, the use of real-time polymerase chain reaction (qPCR) would have been appropriate to distinguish between different Plasmodium species.

VI. CONCLUSION

The prevalence of asymptomatic malaria carriage obtained in the present study indicates that this disease remains a worrying public health problem in Gabon. The existence of such a parasite reservoir in these patients represents a key factor in the transmission of this disease. A significant association was indicated not only between asymptomatic malaria and participants aged between 28 and 57, but also between residence in the villages Mvéngué, Djoutou, and Mouyabi. These results are essential for public health practitioners and policy-makers, as they will help to plan and implement targeted and effective preventive activities for the various malaria eradication programs in both rural and urban areas of Gabon.

VII. ACKNOWLEDGEMENTS

VIII.   AUTHORS' CONTRIBUTIONS

NAM implemented the study and wrote the first draft of the manuscript. TNM, NAM, CF conceptualized the idea, and were involved in the design, implementation and writing of the manuscript. NAM, and NBTG, participated in data collection and review of the manuscript. The authors read and approved the final manuscript.

IX.   FUNDING

X.   DATA AND MATERIAL AVAILABILITY

The dataset used and/or analyzed in the course of this study is available from the corresponding author upon reasonable request.

XI.   CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

[1]. World Health Organization. (2022). World malaria report 2022. World Health Organization.

[2]. World Health Organization. (2020). Malaria eradication: benefits, future scenarios and feasibility: report of the Strategic Advisory Group for Malaria Eradication.

[3]. Al-Awadhi M, Ahmad S, Iqbal J. Current status and epidemiology of malaria in the Middle East region and beyond. Microorganisms. 2021 Feb 9;9(2):338. doi: 10.3390/micro-organismes9020338. PMID: 33572053; PMCID: PMC7915327...

[4]. Murray, C. J., Lopez, A. D., and World Health Organization. (1996). The global burden of disease: a comprehensive assessment of mortality and disability due to diseases, injuries and risk factors in 1990 and projected to 2020: summary. World Health Organization.

[5]. Elnour Z, Grethe H, Siddig K, Munga S. Malaria control and elimination in Kenya: economy-wide benefits and regional disparities. Malar J. 2023 Apr 7;22(1):117. doi: 10.1186/s12936-023-04505-6. PMID: 37029370; PMCID: PMC10080938.

[6]. Reiner Jr, R. C. and Hay, S. I. (2022). The overlapping burden of the three leading causes of disability and death in children in sub-Saharan Africa. Nature communications, 13(1), 7457].

[7]. Boundenga L, Bignoumba M, Dibakou SE, Mombo LE, Moukagni-Mussadji CJ, Wora DM, Kassa-Kassa F, Bisseye C, Onanga R. Diminution des cas cliniques de paludisme de 2017 à 2019 à Franceville, Sud-Est du Gabon, Afrique centrale. J Public Health Afr. 2023 May 4;14(3):1865. doi : 10.4081/jphia.2023.1865. PMID : 37229438 ; PMCID : PMC10204601.

[8]. Bourgarel M, Wauquier N, Gonzalez JP. Menaces virales émergentes au Gabon : capacités sanitaires et réponse au risque de zoonoses émergentes en Afrique centrale. Emerg Health Threats J. 2010;3:e7. doi : 10.3134/ehtj.10.163. EPUB 2010 Juin 3. PMID : 22460397 ; Numéro PMCID : PMC3167654

[9]. Negatu GA, Abebe GA, Yalew WG. Prévalence du paludisme et des facteurs associés parmi les patients soupçonnés de paludisme qui fréquentent le centre de santé Hamusit, dans le nord-ouest de l'Éthiopie : A Cross-Sectional Study. J Parasitol Res. 2022;2022:1306049. Publié le 22 mars 2022. doi:10.1155/2022/13060499

[10].   Hilaire Moundounga Kenguele, Thiéry Ndong Mba, Cedric Sima Obiang, Elvis Othogo N Nang, Bourdettes Meye, Cyrille Bisseye, Joseph Privat Ondo, Louis-Clément Obame Engonga, Patrick Mickala, Prevalence of parasitic infections in Motobo and surrounding villages in South-eastern Gabon : a relevantstudy in rural Central Africa International Journal of Innovative Science, Engineering & Technology, Vol. 8 Issue 10, October 2021 ISSN (Online) 2348 - 7968 | Impact Factor (2020) - 6.72 www.ijiset.com

[11].   Abdelsalam Adoum DOUTOUM , Djamalladine Mahamat DOUNGOUS , Elysée Gabdibé GONDIMO3 , Richard Dounbé LAOUGANGTA3 , Abderaman ADOUM , Badawe GARANDI and Nicolas Yanou NJINTANG Prevalence and

risk factors associated with malaria in patients at Abéché Provincial Hospital (Chad) Int. J. Biol. Chem. Sci. 13(4): 1995-2004, August 2019 ISSN 1997-342X (Online), ISSN 1991-8631 (Print) © 2019 International Formulae Group. All rights reserved. 8152-IJBCS DOI: https://dx.doi.org/10.4314/ijbcs.v13i4.7 Original Paper http://ajol.info/index.php/ijbcs

[12].   Nyamusore, J., Nahimana, M. R., Ngoc, C. T., Olu, O., Isiaka, A., Ndahindwa, V., Dassanayake, L., & Rusanganwa, A. (2018). Risk factors for transmission of *Salmonella Typhi* in Mahama refugee camp, Rwanda: a matched case-control study. The Pan African medical journal, 29, 148

[13].   Hayuma PM, Wang CW, Liheluka E, Baraka V, Madebe RA, Minja DTR, Misinzo G, Alifrangis M, Lusingu JPA. Prevalence of asymptomatic malaria, submicroscopic parasitaemia and anaemia in Korogwe district, northeastern Tanzania. Malar J. 2021 Oct 29;20(1):424. doi: 10.1186/s12936-021-03952-3. PMID: 34715886; PMCID: PMC8555315

[14].   Pathak S, Rege M, Gogtay NJ, Aigal U, Sharma SK, Valecha N, Bhanot G, Kshirsagar NA, Sharma S. Age-dependent sex bias in clinical malarial disease in hypoendemic regions. PLoS One. 2012; 7(4):e35592. doi: 10.1371/journal.pone.0035592

[15].   Joel Djoufounna, Marie Paul Audrey Mayi, Roland Bamou, Juluis Visnel Foyet, Raymond Tabue, Michel Lontsi-Demano, Dorothy Achu-Fosah, Christophe Antonio-Nkondjio, Timoléon Tchuinkam, ; High prevalence of asymptomatic Plasmodium falciparum malaria in Makenene, a locality in the forest-savannah transition zone, Centre Region of Cameroon, Current Research in Parasitology & Vector-Borne Diseases, Volume 2, 2022, 100104, ISSN 2667-114X, https ://doi. org/10.1016/j.crpvbd.2022 .100104.

[16].   Siddiki, V.K. Payne, Y. Cédric, N.A.C. Nadia ; Effet des moustiquaires imprégnées sur la prévalence du paludisme chez les femmes enceintes dans la subdivision de Foumban, région ouest du Cameroun. J. Parasitol. Résolution 2020 (2020), article 7438317, 10.1155/2020/7438317]

[17].   Mensah BA, Myers-Hansen JL, Obeng Amoako E, Opoku M, Abuaku BK, Ghansah A. Prevalence and risk factors associated with asymptomatic malaria among school children : repeat-cross-sectional surveys of school children in two ecological zones in Ghana. BMC Santé publique. 2021 Sep 17;21(1):1697. doi : 10.1186/s12889-021-11714-8. PMID : 34535112 ; Numéro PMCID : PMC8447720.

[18].   Kanwugu ON, Helegbe GK, Aryee PA, Abdul-Karim A, Anaba F, Ziblim Z, Amevi ED. Prévalence du paludisme asymptomatique chez les enfants de la métropole de Tamale : comment le TDR PfHRP2 CareStart se comporte-t-il™ contre la microscopie ? J Trop Med. 2019 ; 2019:6457628-6457627. doi : 10.1155/2019/6457628

[19].   Djoufounna J, Mayi MPA, Bamou R, Foyet JV, Tabue R, Lontsi-Demano M, Achu-Fosah D, Antonio-Nkondjio C, Tchuinkam T. High prevalence of asymptomatic Plasmodium falciparum malaria in Makenene, a locality in the forest-savanna transition zone, Central Region of Cameroon. Curr Res Parasitol Vector Borne Dis. 2022 Nov 28;2:100104. doi: 10.1016/j.crpvbd.2022.100104. PMID: 36504597; PMCID: PMC9731883.

[20].   Hosch S., Yoboue C.A., Donfack O.T., Guirou E.A., Dangy J.-P., Mpina M., et al. Analysis of nucleic acids extracted from rapid diagnostic tests reveals a significant proportion of false-positive test results associated with recent malaria treatment. Malar. J. 2022; 21:23