

Prevalence of Malaria among Patients at the Sino-Gabonese Friendship Hospital in Franceville: A Two-Year Retrospective Study

Thiéry Ndong Mba^{1,2*}, Cedric Sima Obiang², Hilaire Moudounga Kenguele¹, Ulrick Nzamba³, Pierre K Bithegue Mba³, Arnaud Brice Pambo-Pambo⁴, Louis-Clément Obame Engonga²

1- Laboratory of Molecular and Cellular Biology (LABMC), University of Science and Technology of Masuku (USTM), Franceville, Gabon

2- Laboratory of Research in Biochemistry (LAREBIO), University of Sciences and Techniques of Masuku (USTM), Franceville, Gabon

3- Medical Analysis Laboratory of the Sino-Gabonese Friendship Hospital, Franceville, Gabon

4- Laboratory of Animal Physiology (LAPHYA), University of Science and Technology of Masuku (USTM), Franceville, Gabon

Abstract :-

Introduction: Despite the strong commitment of health authorities to the elimination of malaria, this infectious disease is still responsible for high morbidity and mortality worldwide. In Gabon it continues to be a public health burden. The objective of this study was to assess the prevalence of malaria among patients at the Sino-Gabonese Friendship Hospital in Franceville, in the southeast of the country.

Methods: A retrospective and cross-sectional study was conducted in a hospital setting, based on the results of microscopic examinations of thickened drops, recorded in the registers of the medical analysis laboratory of the Sino-Gabonese Friendship Hospital in Franceville, from June 2019 to May 2021.

Results: In this study, the prevalence of malaria among patients at the Sino-Gabonese Friendship Hospital in Franceville was 32.54% 95% CI = [0.29 - 0.30]. The age of the study participants ranged from 15 to 49 years (mean age 24.79 years). We observed that with 1776 cases and a percentage of 58.91% ($p < 0.001$), women were more infected than men, the age group most infected by malaria was 14 to 49 years, with 1156 cases or 38.34%. The seasonal distribution of malaria during the study period indicated that quarters 3 and 7 including the months of December, January and February, with respectively 609 (21.95%) and 557 (20.07%) cases of malaria, corresponded to the short dry season (December to January) and the beginning of the long rainy season (February to May).

Conclusion: The results of this study underline the need to break the chain of malaria transmission. Thus, planning and monitoring of malaria control measures should be intensified throughout the year in Franceville, South-East Gabon,

Keywords:- Prevalence; Malaria; Sino-Gabonese Friendship Hospital; Franceville; South-East; Gabon.

I. INTRODUCTION

Malaria is a parasitic infection, tropical and intertropical, associated or not with clinical signs, it is identified in the body, by the presence of a parasite belonging to the genus Plasmodium, carried to humans by mosquitoes of the genus Anopheles. A distinction is made between malaria-infestation or asymptomatic and malaria-disease [1]. Malaria remains today a great scourge for humanity. Indeed, worldwide, WHO has estimated 241 million cases with 627,000 deaths in 2020 against 227 million cases with 558,000 deaths in 2019, with the highest number recorded in the WHO African region [2]. As malaria continues to plague the world, it remains highly endemic in sub-Saharan African countries [3]. This is the case, on the one hand, in the Democratic Republic of Congo, where between 2016 and 2019, the burden of malaria cases increased by 7%, from 305 to 226 per 1000 of the population at risk [4], and on the other hand, in Niger, 5.2 million cases and 10,000 deaths were recorded in 2015 [5]. Located in central Africa and crossed by the equator, Gabon enjoys a hot and humid climate. These conditions are conducive to the development of Plasmodium, giving this country the status of a malaria endemic country. Moreover, according to Gabon's malaria control program, 45% of medical consultations in health facilities concern malaria. Children and pregnant women represent 71% of these [6]. Moreover, it has been indicated that malaria remains not only the first cause of consultation of health structures, of school absenteeism for children, and workers for adults, but also of death [7]. Despite the existence of numerous studies on malaria in Gabon, and the efforts made by the government to improve access to health care and the quality of services for the fight against malaria, the fact remains that this disease remains a real public health problem for the populations of this country. It is in this context that the main objective of this study was to evaluate the prevalence of malaria among patients at the Sino-Gabonese Friendship Hospital during the two years preceding the study period.

II. MATERIALS AND METHOD

A. Study setting

This study was carried out in the laboratory of the Sino-Gabonese friendship hospital in Franceville. Located in the 2nd district of this city, the hospital has an adequate technical platform for most medical examinations. Franceville is the provincial capital of Haut Ogooué, in the south-east of Gabon. The average seasonal high is 31°C, and the minimum is 23°C. This means that the average temperature in Franceville is 27°C. As in all other cities in the interior of Gabon, despite the efforts of the political authorities, factors such as sanitation, water supply and drinking water are not very good in the city of Franceville, which has urban slums and under-integrated neighborhoods as neighbors. The use of contaminated river water or water from the Mpassa River for washing clothes, dishes or even drinking water makes the population very vulnerable to food and water-borne diseases [8].

B. Type, period, and study population

This retrospective, cross-sectional study was conducted in the medical analysis laboratory department of the Sino-Gabonese Friendship Hospital in Franceville between June 2019 and May 2021. It was carried out on the basis of the results of malaria examinations performed by thick drop, recorded and consigned in the registers of the said laboratory.

C. Sampling method

In order to target and focus only on the results of malaria examination by thick drop microscopy during the study period, a purposive sampling was used. The representativeness of the study was guaranteed, the sample size depended on the number of cases registered in the laboratory database of the Sino-Gabonese Friendship Hospital of Franceville. For this study, the parameters retained for each patient were: Age, sex, and examination result during the study period.

D. Procedure for obtaining data

The data used for the study were results from the medical analysis laboratory of the Sino-Gabonese Friendship Hospital in Franceville. Access to these data was facilitated by a letter N° 417/MS/SG/DRSSE/ HASG from the management of this hospital authorizing us to carry out this study. The extracted data were made available to us in digital form. All the results of malaria examinations from June 2019 to May 2021 were extracted and used for the study.

E. Inclusion and exclusion criteria

The parameters and results of all persons who had a malaria examination (thick drop) between June 2019 and May 2021 at the medical analysis laboratory of the Sino-Gabonese Friendship Hospital in Franceville were included in this study.

Excluded from the study were the results of persons suspected of having malaria, but without laboratory confirmation, and the results of doubtful or incomplete examinations.

F. Ethical considerations

The data received did not include the identity or personal information of the patients.

G. Statistical analysis of the data

Entered in a Microsoft Excel 2016 format, the data were then analyzed with R software version 3.6.1, including measurement of rates and associations. An exact binomial test was used to determine correlations might exist between typhoid fever prevalence and certain values. A 95% confidence interval was estimated, and a $p \leq 0.05$ value was considered statistically significant.

III. RESULTS

A. Demographic characteristics of malaria patients

Between June 2019 and May 2021, a total of 9266 patients who consulted for the thick drop examinations were collected for this study. With a sex ratio of 1.56, women were in the majority with, 5649 patients than men who counted 3617 patients. With an average age of 18.63 years, the most represented age group was 15 to 49 years with 3838 or 41.42%, followed by 0 to 4 years with 2526 patients or 27.26%, 5 to 14 years or 19.32% and finally over 50 years with 1111 patients or 12%. Table 1

Age groups	Male	Female	Total
0 – 4 years	1300	1226	2526
5 – 14 years	897	894	1791
15-49 years	1097	2741	3838
≥ 50 years	323	788	1111
Total	3617	5649	9266

Table 1: Demographic characteristics of patients during the study period

B. Distribution of the rate of patients diagnosed positive for malaria by sex at the medical analysis laboratory of the Sino-Gabonese Friendship Hospital during the study period

Among the 9266 patients collected in this study, 3015 (32.54%) patients suffered from malaria. There were 1239 or (41.09%) males and 1776 or (58.91%) females, Figure 1.

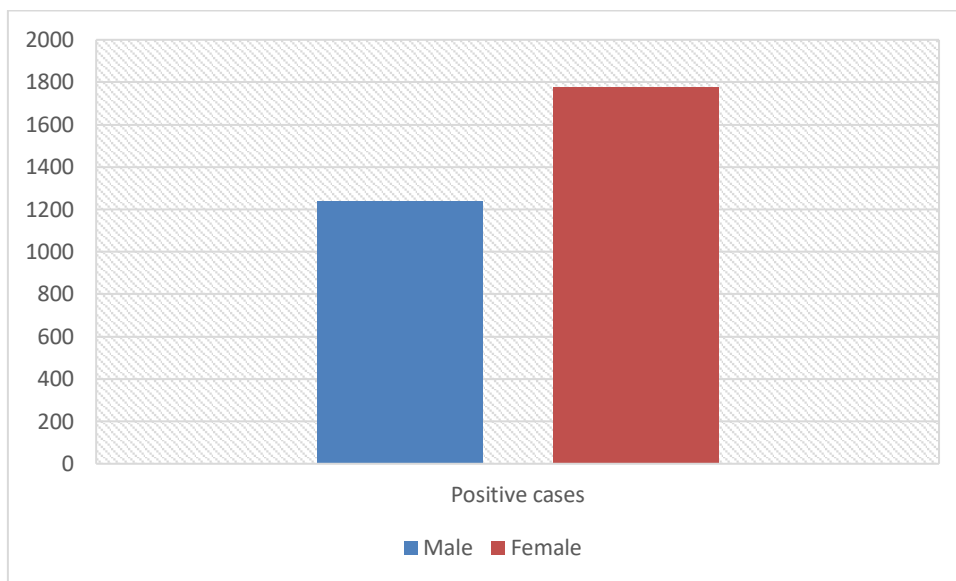


Fig. 1: Distribution of positive malaria cases by sex during the study period

C. Distribution of the rate of patients diagnosed positive for malaria by age group at the medical analysis laboratory of the Sino-Gabonese Friendship Hospital during the study period

The greatest number of malaria cases was recorded among women compared to men in all other age groups except for the 0-4 year age group, in which only 392 cases were recorded compared to 445 cases among men. The age group of 15 to 49 years with 1156 or 38.34% of malaria cases was the most affected, followed by the 0 to 4 years with 837 cases or 27.76%, then the 5 to 14 years with 785

cases or 26.04%, and finally the 50 years and over with 237 cases or 7.86%. While the lowest percentage of cases among men was recorded in the age group of 50 years and over with 78 cases or 2.62%, the highest rate among women was in the age group of 15 to 49 years with 822 cases or 27.26%. For both men and women, the age group 50 years and older with 79 cases (2.627%) and 158 cases (5.24%) respectively, recorded the lowest number of malaria cases among patients at the Sino-Gabonese Friendship Hospital in Franceville during the study period. Figure 2.

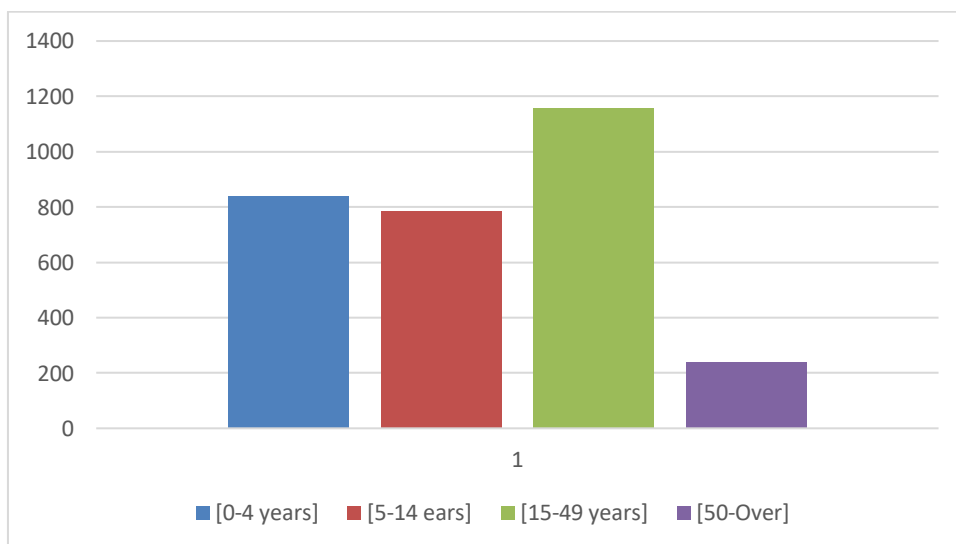


Fig. 2: Distribution of the rate of patients diagnosed with malaria by age groups

D. Correlation between malaria infection, gender and age groups

Table 2 shows an analysis of the significance level of the observed differences in the percentage of malaria infection of males versus females by age groups that was performed using the exact binomial test. The test was considered significant when p-value \leq to 0.05 that using a 95% confidence interval, and P-value \leq 0.05, there was a 50/50

difference between the presence of malaria in males and females, which were statistically significant during the study period from June 2019 to May 2021. With 1776 patients and a percentage of 58.91% ($p < 0.001$). 95% confidence interval is [0.57- 0.60], females were more infected than males in whom 1050 patients were recorded with a percentage of 41.09%.

Age groups	Male	Female	Total	Binomial test		
				p(H)	IC95%	p-value
0 – 4 years	445	392	837	0.53	[0.49 - 0.56]	0.07
5 – 14 years	381	404	785	0.48	[0.44 - 0.52]	0.43
15- 49 years	334	822	1156	0.28	[0.30 - 0.34]	< 0.001*
≥ 50 years	79	158	237	0.33	[0.25 - 0.32]	< 0.001*
Total	1239	1776	3015	0.41	[0.37 - 0.40]	< 0.001*

Table 2: Exact Binomial test on the correlation between malaria cases, gender and age groups

* significant test

E. Distribution of malaria cases by age group and by quarter

During the eight quarters of the study period, the age group most affected by malaria was 15 to 49 years old with 1156 cases, i.e. 38.34%, followed by 0 to 4 years old with 837 cases or 27.77%. While quarter 1 had the lowest

percentage of malaria cases during this study with 80 cases or 2.65%, quarter 3 had the highest number of cases as it recorded 903 cases or 29.95%, followed by quarters 7, 6, 4, 2, 8, and 5 with 557, 484, 406, 368, 261, and finally 250 malaria cases respectively. Figure 3.

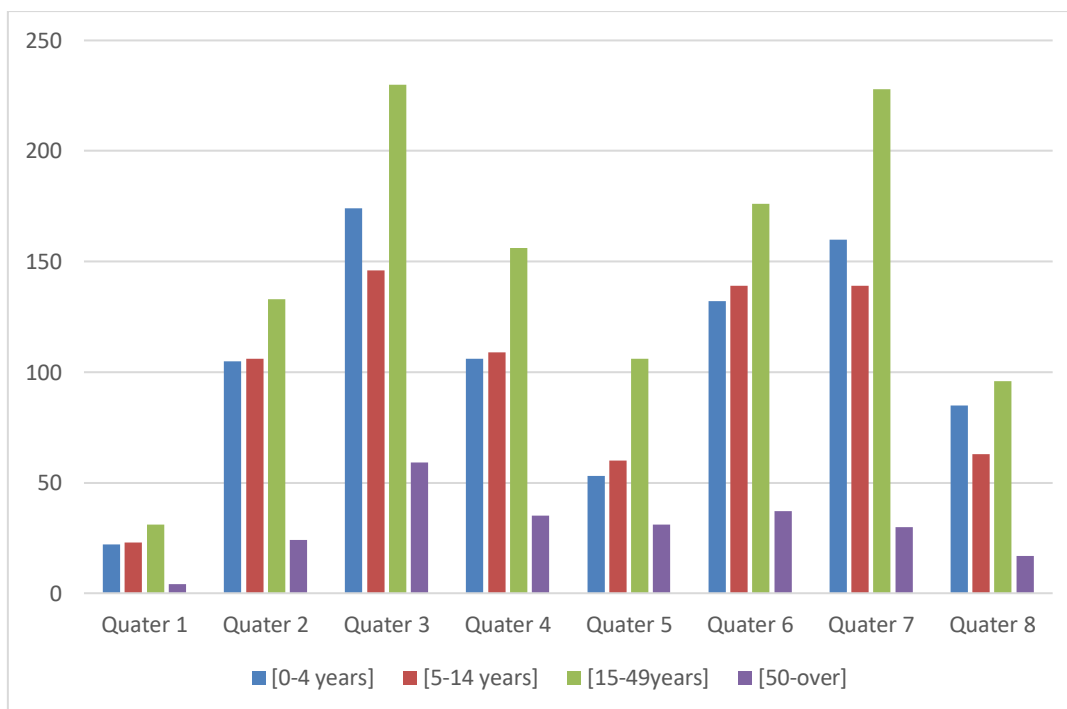


Fig. 2: Distribution of malaria cases by age group and quarter

F. Seasonal distribution of malaria cases during the study period.

During the different quarters (eight quarters), which constituted the period of our study, the prevalence of malaria was unevenly distributed from one quarter to another (Figure 3). The highest prevalence, represented by two peaks, was observed in quarter 3 (609 cases or 20.20%) which includes the months of December, January and February 2019, and quarter 7 (557 cases or 18.47%) which includes the same months in 2021. We note that quarters 3 and 7 include the short dry season (December to January) and the beginning of the long rainy season (February to May). Quarter 1, which includes the months of June, July, and August 2019 representing the beginning of the study,

recorded the lowest number of malaria cases. Quarter 2, which includes the months of September, October, and November 2019, represented by the short rainy season (September to December), recorded 268 or 8.89% of cases, while Quarter 6, which includes the same months but in 2020, recorded 484 or 16.06% of malaria cases. Quarter 4 which includes the months of March, April and May 2020 and quarter 8 which includes the months of March, April and May 2021 including the long dry season (March to September), recorded 406 cases or 13.47% and 261 cases or 8.66% respectively. The seasonal distribution of malaria cases among patients in this study, was significantly different ($p < 0.001$), IC95% [0.20 0.23].

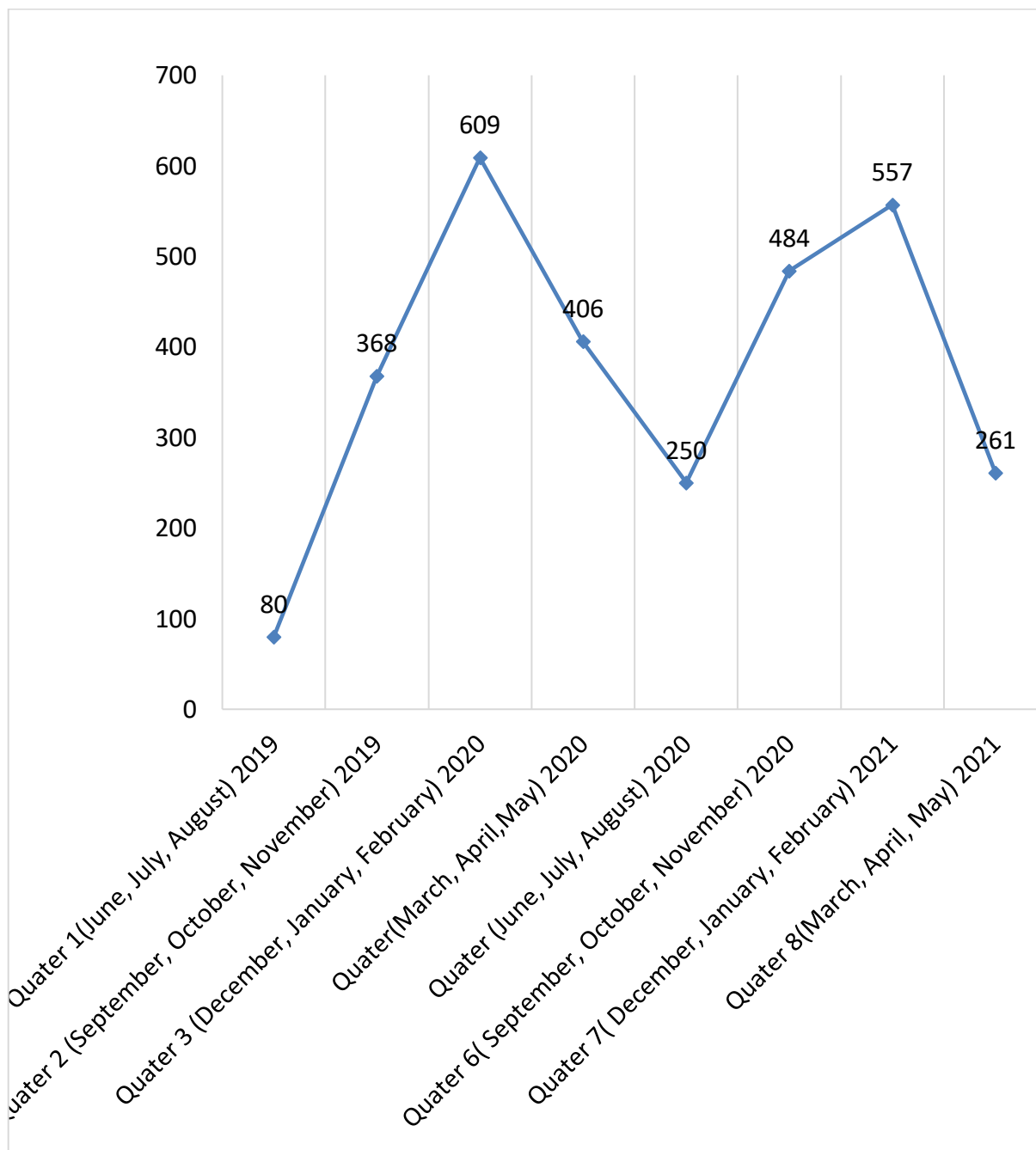


Fig. 3: Seasonal distribution of malaria cases in patients

Quarters	Seasons
1	Large dry season
2	Small rainy season
3	Short dry season and beginning of the long rainy season
4	Large dry season
5	Large dry season
6	Small rainy season
7	Short dry season and beginning of the long rainy season
8	Large rainy season

Table 2: Correspondence between the different quarters and seasons.

IV. DISCUSSION

With the general objective of determining the prevalence of malaria among patients at the Sino-Gabonese Friendship Hospital in Franceville, southeastern Gabon, over a two-year period, this study recorded a total of 9266 patients who consulted the medical analysis laboratory of the Sino-Gabonese Friendship Hospital during the study period. The distribution of participants according to sex gave a sex ratio (F/H) of 1.56, with women in the majority with $n=5649$ (61%) versus $n=3617$ (39%). With an average age of 24.79, the greatest number of participants was recorded among women compared to men in all age groups except those 50 years and older. This result is similar to that of a study in which females constituted 53% of the study population [9]. Of the 9622 participants tested during the study period, 3015 patients were diagnosed as malaria positive, representing an overall prevalence of 32.54%. This result, while higher than 29% obtained elsewhere [10], was lower than the results of previous studies lower than that obtained in two previous studies, one that reported a prevalence of malaria of 38.96% [11], and the other conducted in the Central African Republic that reported a prevalence of 36.57%. [12]. This variability of results can be justified not only by the geographical location of the study sites, but also by the disparity of the study population and the variations in national or local transmission of the disease in different geographical contexts also have their importance on the periods of the studies. In addition, the mode of disparity in the investigative techniques of each laboratory, may also have an effect on the result [13]. With 1776 patients and a percentage of 58.91% ($p < 0.001$), women were more infected than men, in whom 1050 patients were recorded, with a percentage of 41.09%. Contrary to studies that indicated on the one hand, that the frequency of the disease was 35% in women and 38.6% in men [12], and on the other hand, the one indicating that men were more affected than women in Kola Diba health center in Ethiopia [13], our result indicates that women were the most infected. This result is similar to that obtained in a previous study that observed that women were 2.261 times more likely to be infected with malaria than men [14]. This result may be related to the large female population in our study area, without forgetting that, in our traditional societies, the nature of women's occupation and outdoor activities is different from that of men. On the other hand, the origin of the differences in the prevalence of infection between men and women could be explained by the fact that, as the prevalence of HIV is higher among women in the study area, this may contribute to the higher prevalence of malaria found in women, as it is known to cause a loss of immunity, and therefore HIV-infected adults are more likely to have malaria than those who are not infected [15, 16]. In addition, women who have ever been pregnant, lose their acquired semi-immunity in adulthood and are at greater risk of malaria than other adults, which may also contribute to the higher prevalence observed in women [17]. This study indicated that the age group most affected by malaria was 15-49 years. This figure is justified by the majority of this age group in the study. On the other hand, the 0-4 year age group was well represented by many malaria cases. This result is consistent with most studies conducted in Africa in

general and in Gabon in particular. These studies report a high prevalence of malaria in children under 5 years of age [4, 15, 18]. This could be explained by the fact that in this age group, children are less immune to malaria. The seasonality of malaria observed in this study, presented two high malaria prevalence peaks, in February 2020 and 2021, at the beginning of the major (long) rainy season (February to May). Although in Accra, Ghana, the peak of malaria had been reached in July and August, the result of our study was also reported there, immediately after the peak of rainfall in June [19]. Unlike studies that observed a high frequency of malaria cases in October and December corresponds respectively to the beginning of the dry season [20], our may be related to the fact that a high rainfall. This can be explained by not only the establishment of adequate wet conditions in which plasmodium disseminates easily [21].

V. CONCLUSION

Despite the progress made in the fight against malaria, it remains a serious public health problem in Gabon. The prevalence of malaria parasites in patients at the Sino-Gabonese Friendship Hospital in Franceville remained relatively high at 38.96%. The presence of such a parasite reservoir in these patients represents a key factor in the transmission of malaria. Our results are essential for public health practitioners and policy makers as they can help plan and implement targeted and effective preventive activities for the various malaria eradication programs in semi-urban areas such as Franceville.

ACKNOWLEDGEMENTS

The authors would like to thank the Regional Director of Health of the South East in Franceville for his kind permission to present this article. They also thank Dr. Mireille Dibo, Director General of the Sino-Gabonese Friendship Hospital in Franceville, for her assistance in this study.

- **Authors' contributions:** Study conception and design: TNM, CSO, HMK, UN, BMKP, ABPP, LCOE. Data collection, analysis and interpretation: TNM, CSO, HMK, UN, BMKP, ABPP, LCOE. Manuscript writing and critical review: TNM, CSO, HMK, UN, BMKP, ABPP, LCOE. Approval of the final version of the manuscript: TNM, CSO, HMK, UN, BMKP, ABPP, LCOE
- **Funding :** This research did not receive any specific grant from any public, commercial, or nonprofit funding agency.
- **Availability of data and materials :** This study used data from the electronic data collection system from the laboratory of the Sino-Gabonese Friendship Hospital in Franceville. All data used and/or analyzed in this study are included in this published article and are available from the corresponding author upon reasonable request.

STATEMENTS

- **Ethical approval and consent to participate :** This study was approved by an authorization to access health data by letter N° 252/MS/SG/DRSSE, from the South East

Regional Health Directorate in Franceville Gabon and a letter N° 417/MS/SG/DRSSE/ HASG from the Management of the Sino-Gabonese Friendship Hospital in Franceville.

• **Competing interests** : All authors declare that there were no competing interests. All authors had no potential conflicts of interest regarding the publication of this article.

• **Contributor Information**

- Ndong Mba Thiéry, Email: tndongmba2021@gmail.com
- Sima Obiang Cedric, Email cedricsima@gmail.com
- Hilaire Moudounga Kenguele, Email: hkenguele@gmail.com
- Arnaud Brice Pambo-Pambo, Email: pamboarnaud@hotmail.fr.
- Ulrick Nzamba, Email: ulriknzamb@gmail.com
- Bithegue Mba Kerval Pierre, Email: bitheguepyramide@gmail.com.

REFERENCES

- [1.] Sangaré, I., 2014. Écologie des interactions Anopheles gambiae sl-Plasmodium falciparum et implications dans la transmission du paludisme. BURKINA FASO 155.
- [2.] World Health Organisation, 2021. World malaria report 2021
- [3.] Mabiala, A.N., Obame-Nkoghe, J., Bisseye, C., Tanga, T., Mombo, L.E., 2020. Connaissances et méthodes de lutte contre le paludisme au sein des ménages de la cité minière de Moanda en zone semi-rurale au Sud-Est Gabon. J. Appl. Biosci. 159, 16411–16419.
- [4.] OMS 2020, World Health Organisation (2020), World Malaria Report 2019.
- [5.] Mansour, M. A., Samaila, B., Mahamane, M. L., Mahamadou, D., Ramatoulaye, H. L., & Ibrahim, A. (2019). Facteurs associés au paludisme grave de l'enfant et son pronostic à l'hôpital National de Niamey, Niger. *Médecine d'Afrique Noire*, 66(8/9), 46
- [6.] Nadine N.Ndonghan Iyangui, **Jean-Charles Clanet, et Maryvonne Kombila**, « L'organisation de la prévention antipaludique au Gabon à l'époque coloniale », Cybergeog: European Journal of Geography [En ligne], Espace, Société, Territoire, document 547, mis en ligne le 15 octobre 2011, consulté le 22 avril 2022. DOI : <https://doi.org/10.4000/cybergeog.24196>
- [7.] Mbouloungou, A., Koumba, A.A., Mombo, J.B., Ndonghan Iyangui, N., Mavoungou, J.F., Djeki, J., 2019. Géographie du paludisme dans la région de Libreville-Owendo-Akanda,
- [8.] Climat, météo par mois, température moyenne pour Franceville (Gabon) - Weather Spark
- [9.] Jenkins, R., Omollo, R., Ongecha, M. *et al.* Prevalence of malaria parasites in adults and its determinants in malaria endemic area of Kisumu County, Kenya. *Malar J* 14, 263 (2015). <https://doi.org/10.1186/s12936-015-0781-5>
- [10.] Negatu GA, Abebe GA, Yalew WG. Prevalence of Malaria and Associated Factors among Malaria-Suspected Patients Attending Hamusit Health Center, Northwest Ethiopia: A Cross-Sectional Study. *J Parasitol Res.* 2022;2022:1306049. Published 2022 Mar 22. doi:10.1155/2022/1306049
- [11.] Hilaire Moundounga Kenguele, Thiéry Ndong Mba, Cedric Sima Obiang, Elvis Othogo N Nang, Bourdettes ille Bisseye, Joseph Privat Ondo, Louis-Clément Obame Engonga, Patrick Mickala Prevalence of parasitic infections in Motobo and surrounding villages in South-eastern Gabon: a relevant study 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
- [12.] Abdelsalam Adoum DOUTOUM, Djamalladine Mahamat DOUNGOUS, Elysée Gabdibé GONDIMO3, Richard Dounbé LAOUGANGTA3, Abderaman ADOUM, Badawe GARANDI et Nicolas Yanou NJINTANG Prévalence et facteurs des risques associés au paludisme chez les patients de l'Hôpital Provincial d'Abéché (Tchad) 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>
- [13.] 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. <https://doi.org/10.11604/pamj.2018.29.148.12070>
- [14.] Alemu A., Muluye M., Mihret M., Adugna M., Gebeyaw M. Ten year trend analysis of malaria prevalence in Kola Diba, North Gonder North west Ethiopia. *Parasites and Vectors*. 2012;5(1):p. 173. doi: 10.1186/1756-3305-5-173. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
- [15.] Tay SC, Badu K, Mensah AA, Gbedema SY (2015) The prevalence of malaria among HIV seropositive individuals and the impact of the co-infection on their hemoglobin levels. *Ann Clin Microbiol Antimicrob* 14:64. doi:10.1186/s12941-015-0064-6 Epub 2015 Mar 7
- [16.] Keen Jr, Serghides L, Patel SN, Ayisi J, van Eijk et al (2007) HIV impairs opsonic phagocytic clearance of pregnancy-associated malaria parasites, *PLoS Med* 4 ; e181
- [17.] Ned RM, Price AE, Crawford SB, Ayisi JG, van Eijk AM, Otieno JA et al (2008) Effect of placenta malaria and HIV infection on the antibody responses to Plasmodium falciparum in infants. *J Infect Dis* 198 :1609-1619
- [18.] Steketee RW, Hahjem BL, Parise ME, Menendez C, The burden of malaria in pregnancy in malaria-endemic areas. *Am J Trop Med Hyg.* 2001 ;64(1)28-35, doi :10.4169/ajtmh.2001.64.28 [PubMed] [CrossRef] [Google Scholar]

- [19.] Donovan C, Siadat B, Frimpong J, Seasonal and socio-economic variations in clinical self reported malaria in Accra, Ghana : evidence from facilit data and economic survey. *Ghana Med J.* 2012 ;46(2) :85-94/ [PMC free article] [PubMed] [Google Scholar]
- [20.] Ba O, Sow A, Ba H, Dahdi S, Lo B. Transmission saisonnière du paludisme au niveau de la vallée du fleuve Sénégal: cas de la ville de Kaédi-Mauritanie [Seasonal transmission of malaria in the Senegal River Valley: case study of the city of Kaedi-Mauritanie]. *Pan Afr Med J.* 2019;34:185. Published 2019 Dec 6. doi:10.11604/pamj.2019.34.185.20011
- [21.] Moussa Fane Impacts du climat sur l'écologie et la transmission du paludisme : Analyse du risque palustre dans le Sahel malien Thèse soutenue publiquement le 21/12/2011.