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## RESEARCH ARTICLE

### EPIDEMIOLOGICAL PROFILE OF UNCOMPLICATED MALARIA IN PATIENTS RECEIVED IN 2019 AT THE REGIONAL HOSPITAL OF SÉGUÉLA (CÔTE D'IVOIRE)

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#### ABSTRACT

**Background:** Monitoring of *Plasmodium falciparum* resistance to antimalarial drugs in Côte d'Ivoire takes place on the classic sentinel sites determined by the National Program Control for Fight against Malaria (PNLP) according to the therapeutic efficacy testing approach and/ or coupled with molecular studies. However, areas outside these sentinel sites are not regularly monitored; hence the non-updating of data on the epidemiological profile of malaria in these areas. **Methods:** A cross-sectional and descriptive study was conducted over a period of 3 months at the Regional Hospital of Séguéla (from September to November 2019) to describe the epidemiological profile of malaria in this region of North-West Côte d'Ivoire (Séguéla). **Results:** A total of 3057 patients were included in the study, involving 1621 female (53%) and 1436 male (47%). The average age was 15 years with extremes ranging from 4 months to 65 years. The realization of the thick drops made it possible to count 1614 (53%) positive cases of which the majority were children of less than 5 years. The parasite density varied from 112 to 300000 parasites/μl of blood with an average of 9724 parasites/μl of blood. *Plasmodium falciparum* was the only species found. The parasite index reported during this study was 52.8%. **Conclusion:** Malaria is endemic in the health district of Séguéla with a prevalence higher than that observed nationally.

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## INTRODUCTION

Malaria is a global public health problem. In 2020, the World Health Organization (WHO) recorded 241 million cases of malaria worldwide, including 627,000 deaths. Most of these deaths, 96% (602,000 deaths), come from the African continent. Children under the age of five (80%) are the most affected (WHO, 2021). In Côte d'Ivoire, this condition remains the leading cause of morbidity (30%) and mortality (10%) in the general population. The reported incidence rate of malaria in the Ivorian population increased from 15.5% in 2015 to 19.1% in 2019 (Touré et al., 2021). Faced with the high mortality due to malaria in Côte d'Ivoire, the National Malaria Control Program (PNLP) set up a national malaria surveillance sentinel network in order to collect data relating to the number and distribution of cases of malaria and associated mortality

(Gnagne et al., 2019). These data collected is very important for the design and implementation of disease control programs. Indeed, numerous studies have shown the importance of epidemiological factors in the control of *Plasmodium* infection (Konaté et al., 2018; Koné et al., 2018). They are presented as an alert to the possible appearance of an epidemic and allow the intensification of control measures. The management of the disease comes up against resistance to most antimalarial and the monitoring of this resistance takes place mainly on classic sentinel sites according to the therapeutic approach and/or coupled with efficacy tests to molecular studies (Gnagne et al., 2018). Improved knowledge of malaria in these high-transmission areas coupled with data from sentinel sites will help guide disease management in a more objective manner. The prevalence of malaria in the population, the distribution of plasmodial species, the effectiveness of antimalarial molecules,

the appearance of new resistant strains are very useful indicators for the orientation of disease management to reduce morbidity and mortality linked to malaria. The present study consisted in describing the epidemiological and clinical profile of malaria in patients received at the Regional Central Hospital of Séguéla (CHR).

## MATERIALS AND METHODS

**Type, period and site of the study:** This was a cross-sectional and descriptive study conducted over a period of 3 months at the Regional Hospital of Séguéla (from September to November 2019). Séguéla is a town located 516 km from Abidjan between 7°57'36" North and 6°40'22" West. It is the capital of the Worodougou region. The city of Séguéla is located in a savannah area dotted with gallery forests. The relief is composed of plains and fewer plateau. It is bathed by the Sassandra River and the Bahoroni (tributary of the Marahoué). It covers an area of 11,427 km<sup>2</sup> with a population of about 198,445 (INS, 2014). Séguéla has a tropical climate of the South Sudanese type with an average rainfall of more than 1200 mm of rain per year. The average annual temperature is 28°C with fairly marked daily and seasonal fluctuations. Malaria is the leading cause of consultation and hospitalization in health facilities in Séguéla. Malaria-related mortality and morbidity are significant there. Malaria control strategies are mainly based on insecticide-treated mosquito nets with a level of use that remains quite low and the treatment of clinical cases. The town of Séguéla was chosen as a study site because of its epidemiological facies of the equatorial type, its hydrography and its vegetation favorable to a high anopheline density.

**Patients and data collection:** Were included in the study, all patients without distinction of age or sex who came to the laboratory of the Regional Hospital of Séguéla for suspected malaria during the study period and who gave their informed consent. Using a survey form, the following parameters were collected from each patient, they are: socio-demographic characteristics (age, sex, etc.), clinical data, therapeutic data, results of the thick blood test, blood smear and prescribed antimalarial treatment.

**Sampling:** Random sampling (reasoned decision) was used to select the study population. Thus, all the patients received at the laboratories at the Regional Hospital of Séguéla during the study period were enrolled.

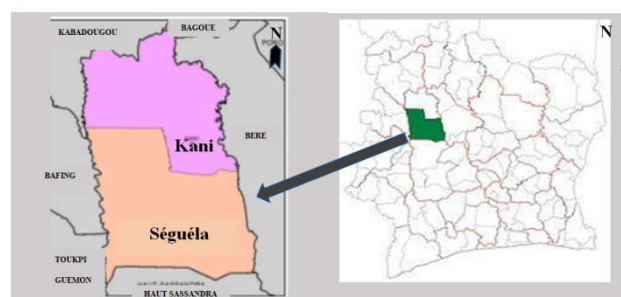
**Performing and reading of thick drop (TD) and blood smear (BS):** Thick blood smear and thin blood smear were performed on the same slide for each patient. To perform TD, a volume of 15 µl of blood was placed on a clean slide using a micropipette. With the end of another blade, the red blood cells were crushed by applying pressure to the blood with circular movements in order to obtain a spot of blood about 1 cm in diameter. For the BS, a 5 µL drop of blood was placed in the middle of the slide using a micropipette. Then, a second blade was placed in contact with the drop of blood at an angle of inclination of 45 degrees, then the blood was spread in the dihedral thus formed. The spreader was pushed quickly, while keeping the same inclination and gradually lifted at the end of spreading. The slides were dried at room temperature then the blood smear was fixed with methanol. They were stained with Giemsa diluted 1/10 for 15 minutes (WHO, 2010). The dye was gently rinsed off with distilled water.

The slides were dried at room temperature and then using immersion oil. They were then observed under an optical microscope with the × 100 objective to determine the parasite density (PD) and identify the plasmodial species. The PD corresponds to the number of asexual forms of the parasite on 200 white blood cells with the rate of 8,000 leukocytes/mm<sup>3</sup> as the standard rate.

**Data analysis:** Data were entered and processed using computer software, Excel Office 2016 and Xltstat version 2014. The chi-squared test (Chi<sup>2</sup> (χ<sup>2</sup>)) was used at the significance level of 0.05 in order to search for the factors having a link with the onset of malaria.

## RESULTS

A total of 3057 were included in the study, involving 1621 female (53%) and 1436 male (47%), i.e. a sex ratio of 0.88. The average age was 15 years (standard deviation = 1.33) with extremes ranging from 4 months to 65 years. The most represented age group was that of 25-49 years (29.47%) (Table 1). The reading of the thick blood smears made it possible to count 1614 (53%) positive cases whose parasite density varied from 112 to 300,000 parasites/µl of blood. The mean density was 9724 parasites/µl of blood (standard deviation = 2476) (Figure 2). *Plasmodium falciparum* was the only species found. The majority of patients (600 patients or 37.17%) with malaria were children aged 0 to 4 years (Table 1). The predominant body temperature was above 37°5 C (Table 2) and the most common reason for consultation was fever, followed by digestive signs (vomiting and diarrhoea) and pain syndromes (headaches, body aches and abdominal pain) (Figure 3). All patients who tested positive for thick blood smear received antimalarial treatment. Among these prescribed products, four (4) drugs come first with a prescription percentage of 63% as shown in Table 3.



(Source: adapted from INS, 2014)

Figure 1. Representation map of the study site (Séguéla)

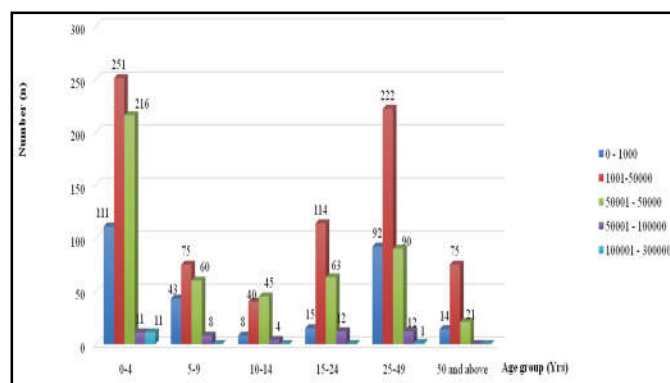


Figure 2. Distribution of patient age according to parasitaemia

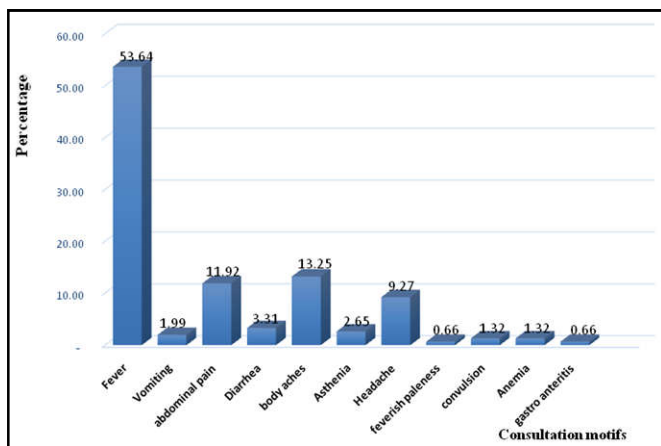


Figure 3. Distribution of patients according to consultation motifs

Table 1. Socio-demographic data of patients

	Positive thick drop Number (%)	Negative thick drop Number (%)	Total
<b>Sex</b>			
Male	775 (48)	661 (45,80)	1436
Female	839 (52)	782 (54,20)	1621
Total	1614 (54)	1443 (46)	3057 (100)
<b>Age group (yrs)</b>			
0-4	600 (37,17)	252 (17,46)	852 (27,87)
5-9	169 (10,47)	97 (6,72)	266 (8,70)
10-14	97 (6)	69 (4,78)	166 (5,43)
15-24	204 (12,63)	371 (25,71)	575 (18,80)
25-49	417 (28,83)	484 (33,54)	901 (29,47)
50 and above	127 (7,86)	170 (11,78)	297 (9,71)
Total	1614 (100)	1443 (100)	3057 (100)

Table 2. Distribution of patients according to body temperature

	Temperature Range (°C)	Number (N)	Percentage (%)	P-value
Temperature	≤ 37°5	809	26,47	0,0001
	>37°5	2248	73,53	
Total		3057	100	

Table 3. Distribution of patients according to the antimalarial treatment used

Molecules used	Number(N)	Percentage (%)
Injection Artemether	565	35
Artesunate + Amodiaquine	226	14
Artemether + lumefantrine	177	11
Injection artesunate	48	3
Not obtained	598	37
Total	1614	100

## DISCUSSION

Malaria is a disease that constitutes a real public health problem in the world in general and in sub-Saharan Africa in particular. The present study showed a male predominance of 53%. However, the statistical data ( $P=0.88$ ) revealed that sex is not related to the occurrence of the disease. It is statistically insignificant. Indeed, the work carried out by Yavo *et al.* and Azagoh-kouadio *et al.* respectively in three sentinel epidemiological surveillance sites (Abengourou, San Pedro and Yamoussoukro) and at the University Teaching Hospital of Treichville have shown that malaria affects both male and female children (Yavo *et al.*, 2015; Azagoh-kouadio *et al.*, 2017).

The results obtained indicate that children under 5 years of age were mainly affected by malaria with high parasite densities. These results are in agreement with those obtained by Bassa *et al.* showing low immunity to malaria in children (Bassa *et al.*, 2016). In malaria-endemic areas, labile immunity develops with age. Younger children acquire this immunity during different episodes of malaria (Ako *et al.*, 2012; Grobusch & Kremsner, 2005). According to the WHO, 80% of malaria cases observed in Africa are attributable to children under five (WHO, 2021). The average parasite density during the study was 9724 parasites/ $\mu$ l of blood. This density is similar to that reported by Koné *et al.* (2015) where an average parasitaemia of 7086 parasites / ml for cases of simple malaria was found in the municipal of Yopougon.

This low average parasitaemia could be explained by the difference in the age of the target population, because apart from children under five years old, our study was interested in a larger population including people aged above 60 years. The inclusion of older people could explain the presence of low parasite densities (Touré *et al.*, 2020). The plasmodium index (PI) found (52.8%) during this study is higher than those found by Boigny (2017) and Assoumou *et al.* (2008), with respective rates of 23.9% and 29.5% in the municipal of Abobo and Yopougon (Abidjan) among children aged 0 to 72 months. This strong PI could be explained by a strong anopheline pressure in this locality. Indeed, the predominant vector species in the Séguéla region is *An. Gambiae*. It is also the most predominant species in all NPFM monitoring sites (Gnagne *et al.*, 2019). Regarding the specific index, the *Plasmodium falciparum* species found in all positive patients (100%) shows that this species remains the majority in this locality.

This result confirms the responsibility of *P. falciparum* in the occurrence of almost all malaria attacks in Côte d'Ivoire (Houngbedji *et al.*, 2016; Gokpeya *et al.*, 2013). In this study, the plasmodium index (52.8%) found reflects the high prevalence of malaria during the study period. Among the various reasons for consultations, fever was the most mentioned in this study, as revealed by several authors (Nagalo *et al.*, 2014). Indeed, in malaria-endemic areas, fever is a common reason for consultation and the diagnosis of malaria is often made on this sole criterion (Koum *et al.*, 2015). However, the reliability of the diagnosis of a malaria attack, based solely on fever as a clinical sign, even by the doctor is limited, because it is common to many pathologies, including bacterial and viral diseases (Serafini *et al.*, 2011; Javelot & Weiner, 2020). Therefore, a thick smear or rapid diagnostic test (RDT) should be performed before any antimalarial treatment (Siala *et al.*, 2010). The thick drop and the blood smear remain the reference methods in the diagnosis of malaria (De Pina *et al.*, 2007). On the therapeutic level, a classification by type of malaria (severe or uncomplicated) could not be made. But according to the register of consultations, it was found that ACTs are the most prescribed in cases of uncomplicated malaria, in accordance with the guidelines of the NPFM because their effectiveness is well established (Angora *et al.*, 2019). Indeed, the first-line treatment of uncomplicated malaria in Côte d'Ivoire is given by the combinations artesunate + amodiaquine or Artemether + lumefantrine. As for the initial treatment used during severe malaria, it is injectable artesunate or injectable Artemether or injectable quinine which is prescribed.

## CONCLUSION

This study was carried out with a view to contributing to the fight against malaria in the health district of Séguéla. The results showed that malaria is endemic in the Séguéla health district with a prevalence higher than that observed nationally. It is therefore necessary to strengthen the strategies for the fight against malaria in this locality.

**Acknowledgment:** We thank the Head of the Regional Central Hospital of Séguéla for providing necessary facilities, help and guidance.

**Ethics:** All the study participants were well informed about the purpose, nature, and outcomes of the study prior to the process of getting informed consent forms.

**Conflicts of interest:** The authors declare they have no relevant conflicts of interest.

**Funding Statement:** No external funding was received for this research.

## GLOSSARY

**BS:** Blood smear

**CHR:** Regional Central Hospital of Séguéla (CHR)

**INS:** National Institute of Statistics

**PNLP:** National Program for Fight against Malaria

**PD:** Parasite density

**PI:** Plasmodium index

**TD:** Thick drop

**WHO:** World Health Organization

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