

**STUDY ON THE
PREVALENCE OF
PLASMODIUM SPECIES
IN THREE PROVINCES
OF ANGOLA, AND
DETERMINATION OF
THE PERCENTAGE OF
MIXED INFECTIONS,
2019**

Pedro Rafael Dimbu

Universidade Agostinho Neto, Medicine
Course, Angola

Filomeno Fortes

Universidade Agostinho Neto Medicine
Course, Angola

Mateusz Plucinski

Centers for Disease Control and Prevention,
Atlanta, USA

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Abstract: In Angola, four types of Plasmodium are diagnosed: P.falciparum, P.Vivax, P.Malariae and P.ovale. P.falciparum is predominant in 87% according to previous studies. Still on the basis of some studies, there is a high percentage of mixed infections (10%) by Plasmodium. The diagnosis of malaria in Angola is based on optical microscopy and rapid testing. The main objective of this study is to know the prevalence of Plasmodium species in three provinces of Angola and to determine the percentage of mixed infections. The methodology used was that of collecting data on the results of plasmodium research, in children aged 6 to 143 months, screened during efficacy studies in three provinces of Angola. Species determination was obtained by optical microscopy with two independent readings. Of the total of 4667 samples collected, 1490 were positive, 1328 (89%) by Pf, 6 (0.4%) by Pv, 67 (4%) by Pm, 14 (1%) by Po and 0 (0%) by Pk. A total of 75 (5%) samples were mixed infections between Pf+Pv (0.1%), Pf+Pm (3%) and Pf+Po (2%).

Keywords: P.falciparum, P. vivax, P.malariae, P.ovale, P.knowlesi, Malaria, Prevalence.

INTRODUCTION

Malaria is an infectious, non-contagious and chronic disease caused by the bite of an infected Anopheles mosquito, whose etiological agent is a parasite of the Plasmodium genus.

By the World Health Organization (WHO), malaria is considered an important public health problem due to its high prevalence and because it is related to low socioeconomic development. The tropical and subtropical areas of the planet are the most affected, with emphasis on Southeast Asia, the Americas and Africa. 90% of all malaria cases and deaths in the world come from Africa.

The disease affects, especially, poor populations with difficult access to health

services, in precarious housing and work conditions.

To control the disease, there are preventive, individual and collective measures, such as the use of repellents, the reduction or elimination of mosquito breeding sites through drainage, drainage, etc. and the use of insecticides, indoor and outdoor spraying, and disease-suppressing drugs in endemic areas.

According to the last malaria report for 2020, an estimated 241 million cases of malaria and 627 thousand deaths. This represents about 14 million more cases in 2020 compared to 2019, and 69 thousand more deaths. Around two-thirds of this additional number of deaths (47,000) were linked to the disruption in provision of malaria prevention, diagnosis and treatment during the COVID19 pandemic.

According to the Center for Processing Epidemiological Data (CPDE) of the Ministry of Health of Angola, in 2019, there were estimated just over 5 million cases of malaria against 8 thousand deaths, while in 2020 there was a significant increase to 7 million cases against 12,000 deaths.

The article was guided by a systematic review of retrospective observational studies to estimate the prevalence of Plasmodium species in three provinces of Angola (Benguela, Lunda Sul and Zaire), where studies of the therapeutic efficacy of antimalarials take place regularly every two years since 2013.

There are reports that in recent years the presence of more than one species of the malaria parasite in a single infected individual has been diagnosed with relative frequency, which is worrying from the point of view of the treatment of these people.

Studies from 2008 (Fortes et al.) demonstrated the existence of about 10% of mixed infections among three of the four species of plasmodia existing in the country. Hence, it was necessary in this study to

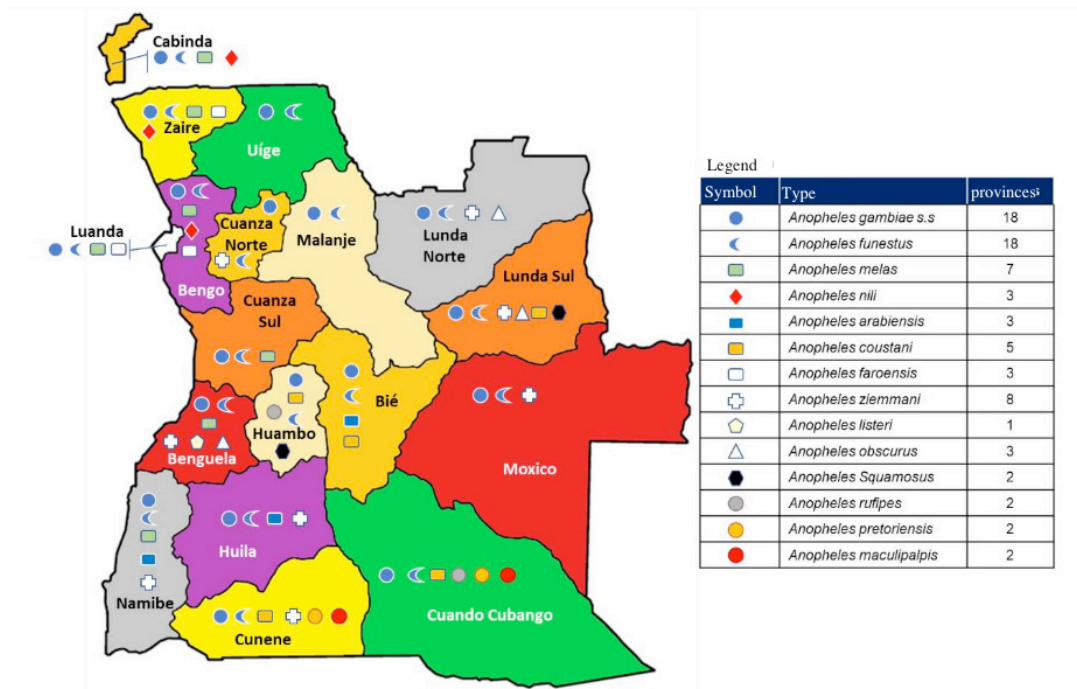


Figure1-Entomological map of AngolaSource: PNCM, 2021

Province	health unit	Total tested	Plasmodium monoinfection					mixed infections		
			Federal Police	PV	pm	Dust	Pk	Pf/Pv	Please/pm	Please
Benguela	HMB	966	296	0	9	0	0	1	25	0
	HGB	1005	194	0	9	0	0	0	4	0
Lunda Sul	HMS	741	222	0	13	0	0	0	1	1
	CS Txz	902	309	5	8	two	0	0	1	0
Zaire	HM Mb.K	540	155	0	22	0	0	0	4	1
	CMI	513	152	1	6	12	0	0	12	25

Tab. 1. Distribution of Plasmodium species and mixed infections in three provinces of Angola, 2019

determine the level of mixed Plasmodium infections.

OBJECTIVES

1. To study the prevalence of Plasmodium species in three provinces of Angola
2. Determine the percentage of mixed Plasmodium infections in the three provinces

THE VECTOR

The WHO estimates that 80% of the world's population is at risk of contracting at least one vector-borne disease. These diseases have the potential for harmful, debilitating and potentially fatal repercussions, causing more than 700,000 deaths worldwide including: malaria, dengue, schistosomiasis, human African trypanosomiasis, leishmaniasis, Chagas disease, yellow fever, Japanese encephalitis and onchocerciasis. However, these diseases are preventable and treatable through individual and collective protection measures and population education. (HWO, 2017).

There are four primary vectors in Angola: *Gambiae* ss, *Melas* and *Arabiensis* (*Anopheles gambiae*), and that of *Anopheles funestus* sl, and six secondary vectors: *A.nili*, *A.coustani*, *A.ziemmani*, *A. faroensis*, *A. pretoriensis*, *A. Listeri*, with a potential transmission role in various parts of the country. In addition to these, other types of vectors can be found in the country (figure 1).

Malaria transmission in Angola is a complex phenomenon due to the presence of multiple vectors, each playing a unique role in insecticide susceptibility that must be taken into account in vector control.

THE PARASITE

The Parasite is a protozoan of the genus *Plasmodium* whose life cycle takes place partly in humans and partly in different

species of mosquito. There are five species of plasmodium that cause human malaria, namely: *P. falciparum*, *P. vivax*, *P. ovale*, *P. malarie* and *knowlesi*. Of these, *P. falciparum* is the most important in most topics, and is responsible for most severe cases and deaths from malaria. (World Malaria Report 2021, WHO).

According to the classification by Ayala et al., 1998, the parasite belongs to the Kingdom Protista, Phylum Apicomplexa, Class Hematozoa, Order Haemosporidae, Family Plasmomodidae and Genus Plasmodium. After infection, in humans, the incubation period varies according to the species, ranging from seven to twenty days for *P. falciparum* (average of twelve), eight to twenty-five for *P. vivax* (average of fourteen) and twenty-five to thirty-seven for *P. malarie* (mean of 30 days). The *P. falciparum* species causes severe malaria associated with high rates of parasitemia (> 100,000 trophozoites/mm³), which makes the disease the main cause of death (Warrell & Gilles, 2002) (Salomão & Pignatari, 2006).

The malaria parasite is transmitted by the female Anop mosquito. *Hthey* Male *Anopheles* feeds only on plant juice and therefore cannot transmit malaria.

The life cycle of the malaria parasite is divided into two phases: One in the mosquito, which is the sporogonic cycle, and two in the human host, which are the erythrocytic cycle that occurs inside the erythrocyte, and the exoerythrocytic cycle, which occurs outside of the erythrocyte. (World Malaria Report 2021, WHO)

METHODOLOGY

The methodology used was the collection of data on the results of the Plasmodium survey, in children aged 6 to 143 months, in three provinces of Angola (Benguela, Lunda sul and Zaire) in 2019, at the timescreening

of participants in the Study of Therapeutic Efficacy of Antimalarials in use in the country. Participants eligible for screening included children with fever or a history of fever with no symptoms of severity. Plasmodium research consisted of making a thick drop and smearing on a microscopic slide, then stained with 3% Giemsa dye. Subsequently, the slide was observed by two technicians and the results compared and harmonized. For Quality Control of the slides, a supervisor supervised the slides.

RESULTS

Of the total of 4667 samples collected, 1490 were positive, 1328 (89%) by Pf, 6 (0.4) by Pv, 67 (4%) by Pm, 14 (1%) by Po and 0 (0%) by Pk. (Table 1).

75 samples (5%) samples were mixed infections between Pf+Pv (0.1%), Pf+Pm (3%) and Pf+Po (2%) (Table 2).

CONCLUSIONS

The prevalence of Plasmodium species in three provinces of Angola are:

1. *P.falciparum*: 89% (with a predominance for the provinces of Lunda Sul with 94% and Benguela with 91%), *P. vivax*: 0.4%, *P. malariae*: 4%, *P. ovale*: 1% and *P. knowlesi*: 0%

2. There is a prevalence of mixed infections of 5% with a predominance for the province of Zaire with 11% and lower for the province of Lunda Sul.

RECOMMENDATIONS

1. The results of the study show the existence of other species of plasmodium, not *falciparum*, a fact to be taken into account in the types of rapid tests to be used in the country, in order to facilitate the diagnosis of other species.

2. Optical microscopy plays a fundamental role in the diagnosis of other non-

falciparum species. It is necessary to invest in optical microscopy, microscopists and quality control to always guarantee reliable results.

3. That in future works, the study be more comprehensive, involving more provinces and not limiting age groups.

LIMITATIONS

This study had some limitations such as non-representative sampling (only one municipality per province) and exclusion of adults.

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Province	tested blades	Plasmodium genus positive	Plasmodium mono-infection										mixed infections						Total Mixed infections	
			Federal Police		PV		pm		Dust		Pk		Pf/Pv		Pleise/pm		Pleise			
			No	BR	No	BR	No	BR	No	BR	No	BR	No	BR	No	BR	No	BR	No	BR
Benguela	1971	538	490	91%	0	0%	18	3%	0	0%	0	0%	1	0.2%	29	5%	0	0%	30	6%
Lunda Sul	1643	562	531	94%	5	1%	21	4%	two	0.4%	0	0%	0	0%	two	0.4%	1	0.2%	3	1%
Zaire	1053	390	307	79%	1	0.3%	28	7%	12	3%	0	0%	0	0%	16	4%	26	7%	42	11%
Total	4667	1490	1328	89%	6	0.4%	67	4%	14	1%	0	0%	1	0.1%	47	3%	27	two %	75	5%

Tab. 2. Prevalence of species in three Provinces of Angola, 2019