Epidemiological Report

Malaria
Historic Series 2010 – 2021

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BRIEF HISTORY

Malaria is an infectious disease caused by a protozoan of the genus *Plasmodium* known since antiquity. The importance of environmental conditions and socioeconomic changes in the transmission of the disease has long been recognized.[1] In the state of São Paulo (SSP), deforestation and the broad migratory process allowed the installation, consolidation and dissemination of cases. At the beginning of the 20th century, there were cases of malaria in practically the entire territory of São Paulo. There was the presence of its main vector, *Anopheles darlingi*, in the valleys of large rivers, such as Mogi Guaçu, Piracicaba, Tietê, Jaguari-Mirim, from where it spread through the affluents and was the vector of the most serious form caused by *Plasmodium falciparum*.

In 1932, the São Paulo Health Service created the Section for Studies and Prophylaxis of Malaria, which was transformed the following year into the Inspectorate for Prophylaxis of Malaria, the beginning of the Superintendence for Endemic Disease Control (Sucen). In 1936, the incidence of malaria was increasing in the SSP and reached 149 of the 258 municipalities existing at the time. In the 1930s to 1950s, the disease was frequent in almost all regions of SSP.

At the 9th World Health Assembly in Geneva (1956) a resolution was made asking governments to eradicate malaria before insecticide resistance developed. In 1958, the government of São Paulo created the Plan for the Eradication of Malaria, which, four years after its implementation, managed to drastically reduce the incidence of the disease in several regions where transmission was within the home, there were no animal reservoirs and the insecticide DDT (dichlorodiphenyltrichloroethane) was extremely effective. In 1960, 10,179 cases of malaria were recorded in the state. In 1965, it was possible to discontinue the use of DDT in some localities, but in others foci of the disease still persisted. In the second half of the 1970s and throughout the 1980s, with the process of occupation of the Amazon and the opening of highways in the North and Center-West regions of the country, there was an increase in imported malaria cases in the SSP.

At the beginning of 2002, attention to the disease was decentralized, which had always been carried out by Sucen, responsible for entomological control, epidemiological surveillance, diagnosis and treatment, the latter two being carried out in 16 reference centers, installed in public hospitals of different state regions. Since 2007, the epidemiological surveillance of malaria has been transferred to the Division of Zoonotic and Vector-borne Diseases of the Epidemiological Surveillance Center "Professor Alexandre Vranjac", using the same system that was already used for other diseases of compulsory notification in the SSP, Sinan Net.

The incidence of autochthonous malaria in São Paulo has been quite limited, with the presence of small punctual outbreaks. It is restricted, today, to the Atlantic Forest region of the coast, where

the responsible vector is *A. (kerteszia) cruzi*, that grows in bromeliads and is not a competent vector for Plasmodium falciparum. Eliminating this residual malaria in the SSP is not a viable goal, since transmission takes place outside the home, there are animal reservoirs (non-human primates) and it is impracticable to use DDT in the forest. Currently, most human cases recorded in the SSP are imported malaria. In addition, the number of cases from other states also dropped substantially, with other countries, especially on the African continent, responsible for the highest percentage of occurrences.

ETIOLOGICAL AGENT

Malaria is caused by a protozoan of the genus *Plasmodium*. In São Paulo, only two species cause the disease in humans: *P. vivax* and *P. malariae*, both species causing less severe forms than P. falciparum, that occurs in the SSP only in imported cases. In Brazil as a whole, even in the Amazon region, where the highest number of malaria cases is recorded, there was no the presence of other *Plasmodium* species, such as *P. ovale* and *P. knowlesi*. In the state of Rio de Janeiro, the presence of *P. simium* was recorded.

TRANSMISSION MODE

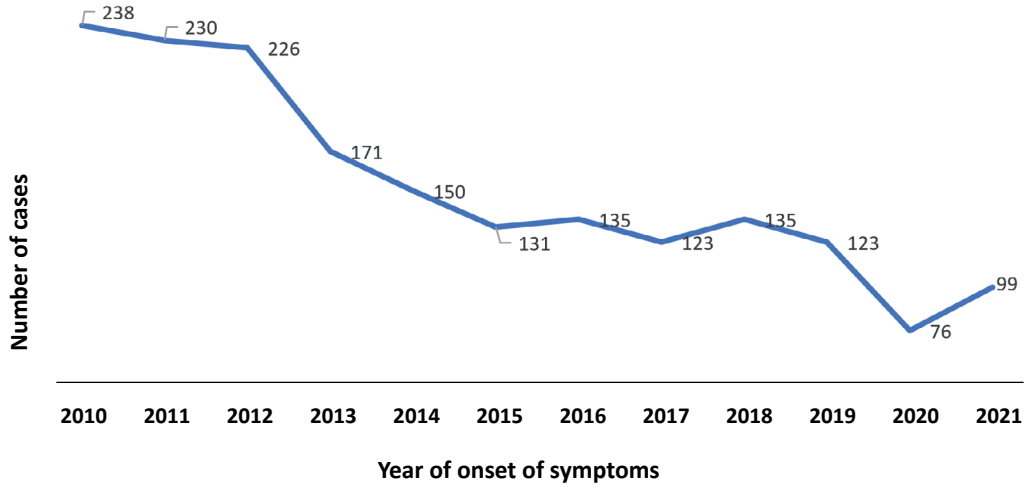
The etiologic agent of malaria is transmitted through the bite of an anopheline mosquito. In the Amazon region, the main vector is *Anopheles darlingi*, an excellent vector for all *Plasmodium* species. In Sao Paulo, in the region where there is residual malaria, in the Atlantic Forest of the coast, the existing vector is *A. (kerteszia) cruzi*, an anopheline that is not competent to transmit *P. falciparum*.

The disease can also be transmitted by blood and blood products, both in transfusion and in the use of injectable drugs. In addition, it can be transmitted from a pregnant woman to the fetus.

EPIDEMIOLOGICAL SITUATION

As shown in Graph 1, the annual number of confirmed malaria cases in the SSP has been falling progressively since 2010.

Graph 1. Confirmed malaria cases in the SSP from 2010 to 2021*, by year of onset of symptoms.



Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022.

Table 1 shows the probable country of infection (PCI) of confirmed malaria cases in São Paulo, in decreasing order of frequency, and Table 2 shows the probable site of infection (PSI) of cases contracted in Brazil by federated unit (FU).

Table 1. Confirmed malaria cases in the SSP from 2010 to 2021*, distributed by probable site of infection (PSI).

PCI – COUNTRY	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
BRAZIL	139	144	132	90	68	36	29	63	60	63	56	66	946
ANGOLA	26	7	12	19	20	23	57	18	13	11	5	9	220
NIGERIA	12	6	17	3	12	15	9	8	17	13		3	115
IGNORED	16	15	8	17	9	5	6	6	9	3	2	10	106
MOZAMBIQUE	3	5	6	6	7	4	10	7	13	8	4	1	74
SOUTH AFRICA	6	7	3	5	3	10	5	5	5	6	2	1	58
CONGO	1	5	2	1	4	11	4	3		2			33
CAMEROON	4	2	8	1	1	4	3	1	1		5	2	32
GUYANA		6	6	5	1	1		2	4	3	1	2	31
FRENCH GUYANA	8	6	2	3	2	1		1	2	1		1	27
VENEZUELA	4	1	3	3				1	6	6	1		25
GHANA		5	7		2	4	5	1					24
EQUATORIAL GUINEA	3	9	2	5	3	1							23
HAITI	5		6		4	1	1						17
IVORY COAST	2	1	2	1	5	1		1					13
GUINEA BISSAU	1	2	2	1		1							7
SURINAME		2		1	1		1		1				6
TOGO		1		4				1					6

PCI – COUNTRY	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
GUINEA			3	1				1					5
INDONESIA		1		1	2			1					5
PHILIPPINES	1		1									2	4
INDIA	1		1		1	1							4
SENEGAL				1		1	1	1					4
AFGHANISTAN	1								2				3
BANGLADESH						2				1			3
BOLIVIA	2											1	3
COLOMBIA				1		1		1					3
PAKISTAN			1			1	1						3
DOMINICAN REPUBLIC					1	2						3	
SUDAN					1	2							3
GABON				1						1			2
LIBERIA		1			1								2
MALAWI					1				1				2
TANZANIA						1				1			2
UGANDA										2			2
VIETNAM	1					1							2
AUSTRALIA						1							1
BENIN								1					1
BURKINA FASO										1			1
CAMBODIA				1									1
CROATIA		1											1
CUBA						1							1
EGYPT	1												1
GUATEMALA		1											1
MALASIA							1						1
NICARAGUA												1	1
NORWAY		1											1
PANAMA			1										1
PERU									1				1
UNITED KINGDOM		1											1
RUSSIA					1								1
SÃO TOME AND PRÍNCIPE					1								1
SIERRA LEONE			1										1
ZAMBIA										1			1
ZIMBABWE	1												1
Total	**238**	**230**	**226**	**171**	**150**	**131**	**135**	**123**	**135**	**123**	**76**	**99**	**1837**

Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022.

Table 2. Confirmed cases of malaria in the SSP from 2010 to 2021* by FU of PSI

PSI-UF	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
RO	59	59	37	30	19	12	6	7	9	7	11	8	264
AM	26	31	16	14	22	8	5	19	21	21	14	20	217
SP	11	9	29	16	3	2	10	16	9	14	10	12	141
PA	19	19	20	13	4	4		2	9	5	4	6	105
AC	11	6	10	6	10	7	3	7	2	6	1	3	72
RR	2	7	2		2		2	6	1	3	6	10	41
AP	4	2	7	6	3	1	2	3	3	4	1		36
MT	4	2	2	1	1	1		2	2	2	8	7	32
MA		4	2	2	2			1	1				12
MS	2	1	3	1	1				2	1			11
BA			2	1	1		1						5
PI		3											3
TO	1	1							1				3
CE		1	1										2
GO	1		1										2
RJ						1					1		2
Total	**140**	**145**	**132**	**90**	**68**	**36**	**29**	**63**	**60**	**63**	**56**	**66**	**948**

Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022.

Table 3 shows the distribution of confirmed malaria cases in São Paulo and PSI in the state itself (autochthonous cases), by probable municipality of infection. It can be noted that the cities with the highest number of cases are: Juquitiba, where a study on malaria is carried out under the responsibility of Sucen (Grande São Paulo Regional), mainly due to the cases of 2017; São Sebastião, of increasing importance due to tourist inns in proximity to the forest, São Paulo and Bertioga, both showing small outbreaks periodically, Itanhaém, Caraguatatuba and Iporanga.

Table 3. Confirmed cases of malaria in the SSP from 2010 to 2021*, by probable municipality of infectionI.

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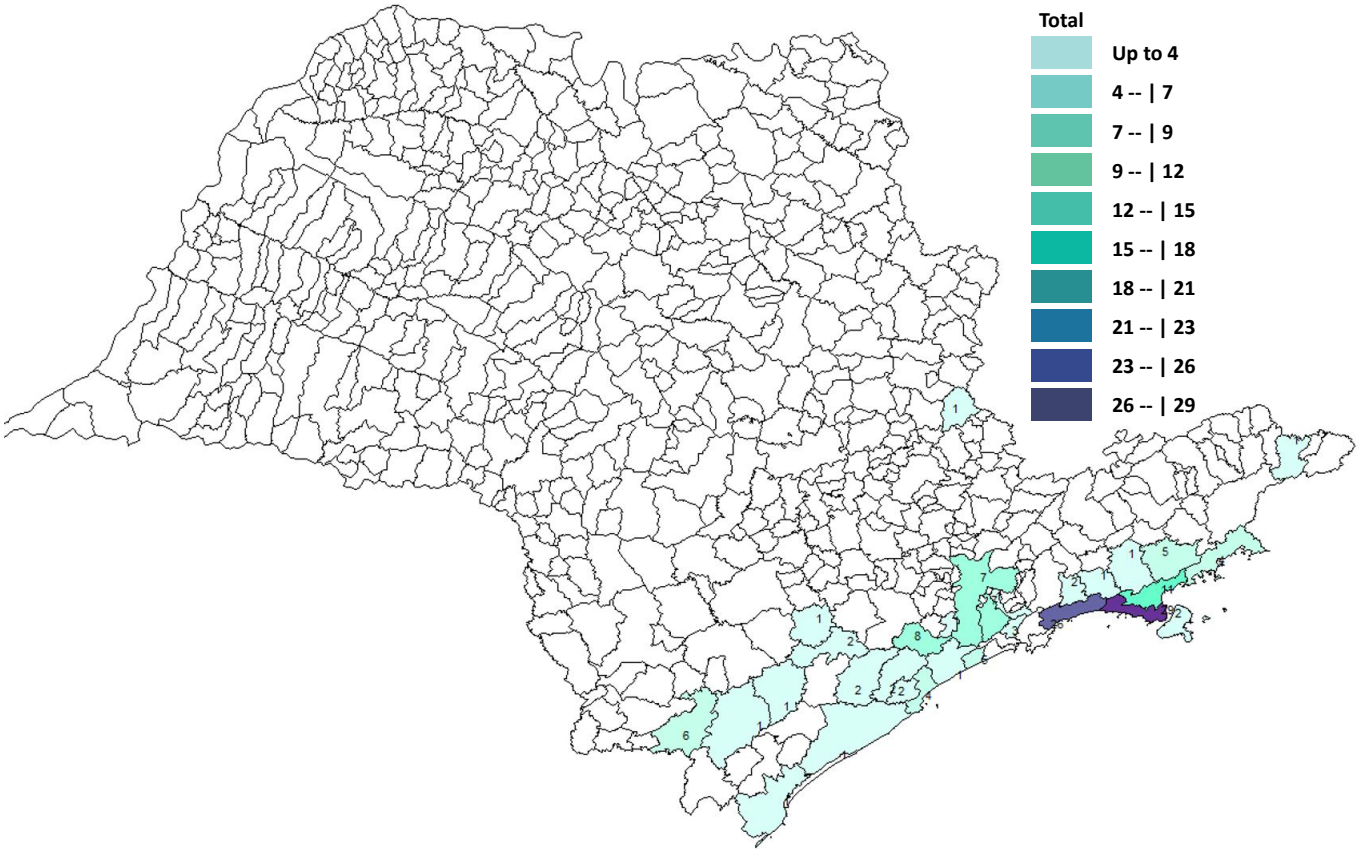
PSI-MUNICIPALITY	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
SÃO SEBASTIÃO		2	2	1	1		5	4	4	2	4	3	28
BERTIOGA			22	2				1				1	26
CARAGUATATUBA						1		6	1	2	1		11
JUQUITIBA	1	2		2	1	1			1		1		9
IPORANGA	1	1	2					1		1	1		7
SÃO BERNARDO DO CAMPO			2	4								1	7
SÃO PAULO	4	1					1			1			7
MONGAGUÁ											1	4	5
NATIVIDADE DA SERRA							1		1	3			5
UBATUBA							1	2				1	4
CUBATÃO	2			1									3
PERUÍBE		2					1						3
BIRITIBA-MIRIM								1	1				2
ILHABELA	2												2
ITARIRI		1					1						2
MIRACATU										2			2
PARAIBUNA										2			2
PEDRO DE TOLEDO				2									2
TAPIRAÍ				2									2
CANANEIA										1			1
ELDORADO								1					1
EMBU-GUAÇU				1									1
IGNORADO	1												1
IGUAPE				1									1
ITANHAÉM											1		1
ITAPIRA			1										1
PILAR DO SUL											1		1
SALESÓPOLIS									1				1
SANTO ANDRÉ												1	1
SÃO JOSÉ DO BARREIRO												1	1
SETE BARRAS					1								1
Total	**11**	**9**	**29**	**16**	**3**	**2**	**10**	**16**	**9**	**14**	**10**	**12**	**141**

Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022.

Figure 1 presents a map of the SSP with the distribution of indigenous malaria cases by the municipalities likely to be infected.

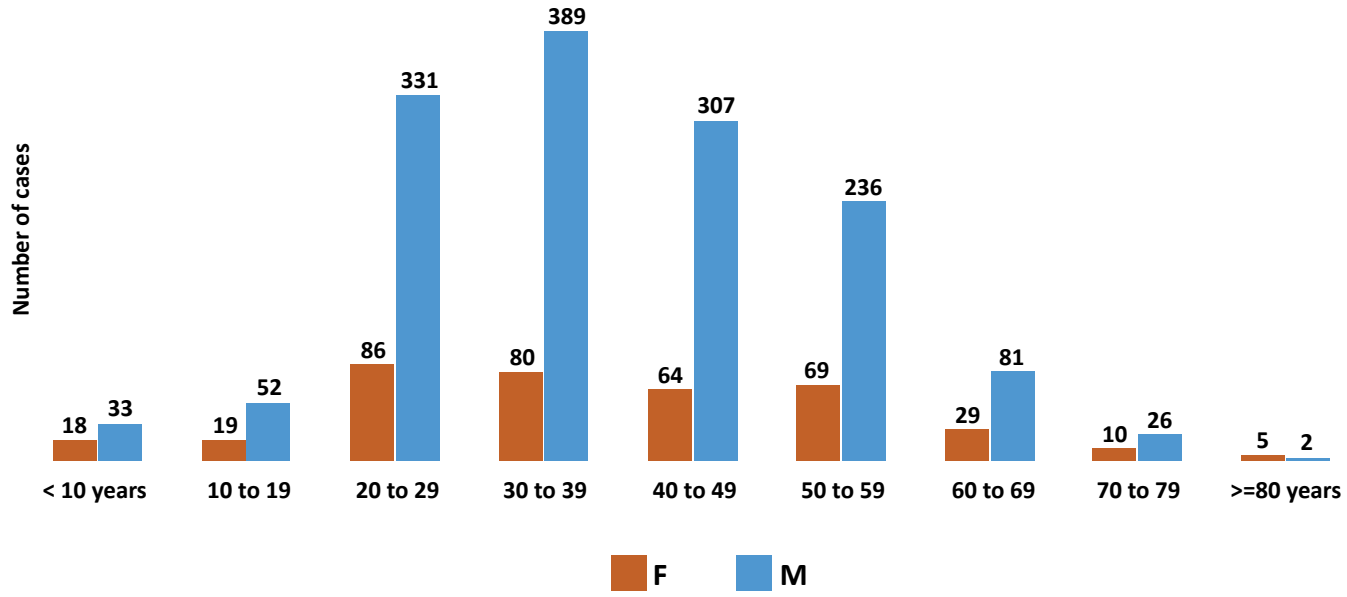
Figure 1. Autochthonous malaria cases in the SSP from 2010 to 2021*, by probable municipality of infection.



Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022.

Graph 2 shows the distribution of confirmed malaria cases in the SSP from 2010 to 2021 by sex and age. It is noted that the predominance is of adult patients, male, of working age. The number of children under the age of 15 and the elderly is quite small.

Graph 2. Autochthonous confirmed malaria cases in the SSP from 2010 to 2021* by sex and age group.

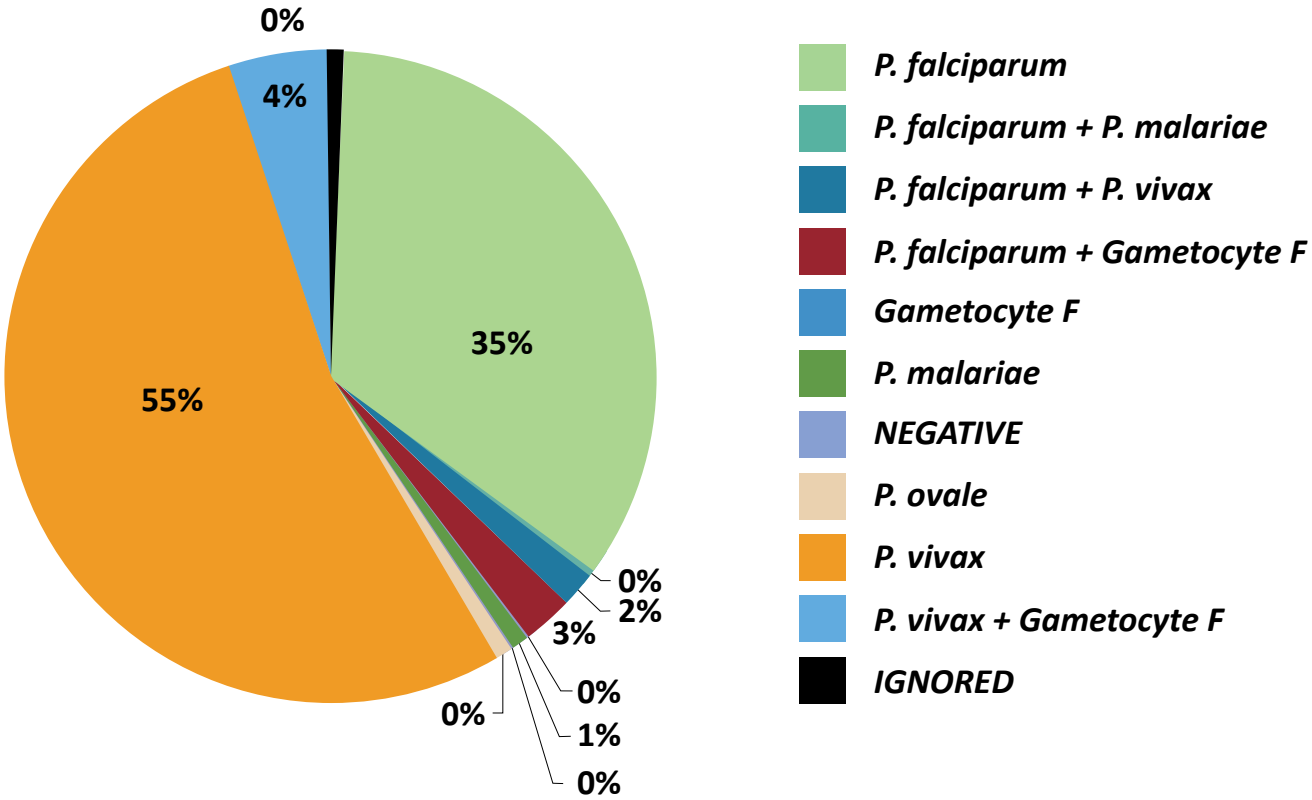


Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022.

Graph 3 shows the proportion of confirmed malaria cases in the SSP according to the *plasmodium* isolated in the parasitological examination (thick smear), the gold standard for diagnosis. It is noted that the *plasmodium* most frequently identified is *P. vivax* (57%), as in the rest of Brazil. Then, with 32% of cases, comes *P. falciparum*, all imported.

Then, to a lesser extent, it is possible to observe *P. vivax* with *P. falciparum* gametocyte with 4%, *P. falciparum* with *P. falciparum* gametocyte (3%) and mixed malaria *(P. vivax* and *P. falciparum*) with 2%. The presence of P. *falciparum* gametocytes is considered important where there is autochthonous transmission, as it is the form that contaminates mosquitoes and will influence the transmission of the disease in the area. In the SSP, this form is less important since there is no competent vector insect.

Graph 3. Confirmed cases of malaria in the SSP from 2010 to 2021*, by *plasmodium* isolated in the confirmatory test.



Source: Sinan Net/CVE/DVZOO. *Provisional data until May 4, 2022. F + FG = *falciparum* plus *falciparum* gametocyte; F + V = *falciparum + vivax*; V + FG = *vivax + falciparum* gametocyte; FG = *falciparum* gametocyte; F+M = f*alciparum + malariae*; O = *ovale*.

The biggest problem facing malaria surveillance is ensuring timely treatment for all cases. Being a disease currently infrequent in the environment, its diagnosis is often made late, because the patient does not seek the services, or the professionals are slow to suspect it. In addition, due to problems in the purchase of imported antimalarials, lack of national production or logistical difficulties, supply problems occur, mainly for chloroquine.

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