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Placental Malaria, Prevalence and Associated Factors in Mbujimayi, Democratic Republic of Congo (DRC)

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Abstract **Case Report**

Introduction: Placental malaria is a secondary condition to malaria during pregnancy and a source of perinatal complications in endemic areas. The aim of this study was to determine the prevalence of placental malaria and associated factors among women giving birth in the town of Mbujimayi in the Democratic Republic of Congo. ***Methods***: A cross-sectional, analytical study was conducted from August 15, 2023 to March 14, 2024 in Mbujimayi. Data were collected on parturients through a combination of interviews, medical records and laboratory analysis. Placental malaria was diagnosed on the basis of histological examination of placental biopsies taken after delivery. Statistical logistic regression models were used to assess factors associated with placental malaria. ***Results***: The average age of parturients was 28.9 years, and 68% were multiparous. Of 178 placentas examined, 86.5% were malaria-infected, including 24.7% with acute infection, 46.1% with chronic active infection and 15.7% with chronic past infection. Illiteracy and less ANC were determining factors (OR 3.22 [1.09 - 82.6] p=0.027 and OR 31.7 [1.5 - 126] p= 0.034); fever and malaria during pregnancy were associated with placental malaria (OR 91.4 [8.33 - 306] p=0.002) and (OR 124 [4.99 - 1645] p=0.016). On univariate analysis, lack of IPT multiplied the risk of placental malaria by 5 (OR 5.25 [2.07 - 15.2] p<0.001). ***Conclusion*****:** Pregnant women's level of education and antenatal care are predictive factors of placental malaria in Mbujimayi, preventive measures and early management of malaria during pregnancy deserve attention.

Keywords: Malaria - Placenta - Associated factors - Mbujimayi.

INTRODUCTION

Malaria in pregnancy is one of the main causes of maternal and infant morbidity and mortality in sub-Saharan Africa [1, 6]. According to World Health Organization (WHO), in 2021 the number of malaria cases was estimated at 247 million, including 619,000 deaths. Sub-Saharan Africa alone accounts for over 95% of global cases and 96% of deaths, with young children and pregnant women being the most vulnerable [7].

In areas of high Plasmodium falciparum transmission, pregnant women are exposed to asymptomatic infection, which can lead to maternal anaemia and placental parasitaemia, resulting in low birth weight [8]. In placental malaria, the secondary condition to maternal infection with P. falciparum infection [9], parasites are sequestered in the placenta due to cytoadherence of parasitized red blood cells placental tissue, involving specific cell-surface adhesive molecules, the best known of which is chondroitin sulfate A. density of available peripheral blood parasites is below the detection limit microscopy and can therefore only be detected by highly sensitive molecular tools [10, 12].

The accumulation of Plasmodium-infected erythrocytes in the intervillous space and the infiltration of immune cells, as well as the thickening of the placenta, cause an alteration in the exchange of nutrients and waste products between the mother and her fetus, resulting in an increased risk of prematurity and stillbirth, intrauterine growth retardation, low birth weight, anemia and congenital malaria [10, 11, 13, 14].

The prevalence of placental malaria is estimated at 25% worldwide, ranging from 5.1 to 58.9% depending on the setting and techniques used [15, 16]. In Jaiberth Antonio's series in Colombia, the prevalence of placental malaria was 27.7%, with 92% of cases diagnosed submicroscopically, and two main plasmodial species, P. Falciparum and Vivax [17]; in sub-Saharan Africa, various studies have reported varying prevalences, ranging from 1.6 to 86.8% depending on the geographical area and diagnostic techniques used [16, 18, 23]. In the Democratic Republic of Congo, a study conducted in Kwilu province reported a placental malaria prevalence of 9.7-17.1% in 2021 [24].

Obstetrical factors related to health services, such as gestational age, antenatal care attendance (ANC) and history of fever during pregnancy, are associated with placental malaria [22, 25].

WHO guidelines, including the use of long-acting insecticide-treated nets (LLINs), intermittent preventive treatment (IPT) with sulfadoxine-pyrimethamine and effective management of malaria and anemia would be the best means of combating the harmful effects of malaria in areas of stable transmission [26]. Numerous studies have demonstrated the benefits of IPT and LLIN in preventing placental malaria and its adverse effects on pregnancy outcome [18, 20, 23, 25].

Kasaï-Oriental province, in central DRC, is an area with stable transmission of plasmodium falciparum and a high burden of malaria-related morbidity. IPTg-SP coverage is very low, at 16% for 3 doses in 2023 [27]; it is in this context that we undertook this study to determine the prevalence of placental malaria and the factors associated with it in Mbuji-Mayi, DRC.

METHODS

Study design, site and population

We conducted an analytical cross-sectional study in Mbuji-Mayi, capital of Kasaï-Oriental province in central DRC, in four health zones within the maternity wards of 4 hospitals: Bonzola, Christ-Roi, Sudmeco and Grâce Divine; the study period ran from August 15, 2023 to March 14, 2024, a duration of 7 months, including site preparation, interviewer training, data collection and biological sample analysis.

The study population consisted of all parturients admitted to the maternity wards of the above-mentioned hospitals during the study period. The minimum sample size was calculated using Schwartz's formula, based on a 9.7% prevalence of placental malaria in Kwilu province (DRC) [24]. Opting for a precision of 5%, the minimum number required after a 10% increase due to study bias was 149 parturients, but we reached 178 parturients. All parturients admitted to the targeted maternity units were eligible for the study, provided they had given informed consent. However, parturients with co-morbidities were excluded from the study (e.g., parturients with chronic conditions such as diabetes mellitus, hypertension, HIV infection or multiple pregnancies).

Data Collection

Data collection was carried out by a multidisciplinary team of 12 midwives (three per targeted maternity hospital), two laboratory technicians, a pathologist, a supervising physician and a principal investigator. These personnel were qualified to carry out activities relating to delivery room management, and had received prior training in data collection for this survey.

On admission to the maternity unit, parturients were informed of the study objectives and invited to participate. After verification of eligibility criteria, they signed the informed consent form before a clinical examination. Data were then collected using a collection sheet, combining several methods: interviews, analysis of medical records, clinical examination and biological analyses. Firstly, interviews were conducted using a structured questionnaire, translated into Tshiluba (the local language), and administered to parturients to gather socio-demographic, clinical and obstetric information. This information was supplemented by analysis of individual medical records, including prenatal consultation records (ANC). Next, two milliliters of maternal venous blood were collected on EDTA for various biological analyses, including a rapid diagnostic test (RDT), microscopic examination of a thick drop and a thin blood smear. Finally, after delivery and macroscopic examination of the delivery, placental section slices of approximately 2-3 cm were taken, extending from the maternal side and involving the full thickness of the placenta in the central regions of each quadrant. These biopsies were fixed in 10% buffered formalin for histological investigation of placental malaria and other possible lesions.

At the same time, all data were entered daily and compiled on electronic sheets designed with the KoboToolbox application (https://kf.kobotoolbox.org/), installed on cell phones. Finally, at the end of the survey, the database was exported in Excel format (Microsoft Office 2010, USA), checked, corrected and consolidated into a single, definitive database.

Laboratory Analysis

Duly labelled EDTA blood tubes were transported daily, within 4 hours of collection, to the analysis laboratory at Valentin Disashi Hospital for testing for *Plasmodium* spp. by RDT and GE by two

experienced laboratory technicians. As soon as the tube was received, drops of blood were pipetted and deposited successively on the TDR device, on the slide for GE and on the thin smear.

The TDR SD Bioline© (Standard Diagnostics Bioline©, South Korea) used is an immunochromatographic test that detects the histidine-rich protein 2 (HRP-2) of *P. falciparum*. Following the manufacturer's instructions, a drop of blood (50 µL) was placed in the reaction well of the test device, then dilution buffer was added. The sample migrated along the test strip and the results were interpreted after 15 minutes. The appearance of a band in the 'control zone' validated the test, while an additional band in the 'test zone' indicated a positive result for *P. falciparum*.

Infection with the various plasmodial species was detected by microscopy on a thin smear (FM) and a thick drop (GE). For the GE, slides were immersed in a solution of Giemsa for 10 to 15 minutes, then carefully rinsed and air-dried. The FMs, spread out and fixed in methanol, were also stained with Giemsa for further analysis. Microscopic examination of the EW began with low magnification, followed by high magnification, enabling Plasmodiums to be identified on the basis of their characteristic shapes (rings, trophozoites, gametocytes) within the red blood cells. Examination of the stained FMs enabled Plasmodium species to be identified on the basis of their distinctive morphologies.

Placental malaria was diagnosed histologically, and vials of placental biopsies fixed in 10% buffered formalin for at least 24 hours and duly labelled were sent to the DITA anatomo-cytopathological analysis laboratory for progressive analysis. Biopsies were placed in successive baths of alcohols of increasing concentration for dehydration, then impregnated in safsolvent of identical concentration, followed by embedding in kerosene before being cut with a Leica microtome. Thin 5µm ribbons were spread on slides previously coated with albumin, then heated to 56°C in the oven for drying. All slides were dipped in the hematoxylin bath for 5 minutes, rinsed with water and then dipped in the eosin bath for 3 minutes, rinsed with distilled water and dipped in the 95% and 100% alcohol baths; finally mounted with glue before being taken to the university clinics in Kinshasa for reading, where histological analysis was carried out under an Olympus binocular microscope at 4X, 10X and 40X magnification. Histopathological analysis was based on the search for histopathological elements that define placental malaria from a microscopic point of view. These included the presence of parasites (free or intraerythrocytic), leukocytes within the intervillous space, malarial pigment in macrophages, fibrin deposits, proliferation of cytotrophoblastic cells and thickening of the trophoblastic basement membrane. These different lesions were categorized according to the BULMER classification (active infection, chronic active infection, chronic past infection, uninfected) [28]

Operational Definitions

- Maternal malaria was defined by a composite indicator including infections detected by a rapid diagnostic test (RDT) targeting the P. falciparum HRP2 antigen or by microscopic examination of a thick drop of blood;
- Placental malaria was defined by the presence of parasites and/or malarial pigment on histopathological analysis of the placenta
- Acute infection or category 1 was defined by the presence of parasite and absence of malar pigment;
- Chronic infection or category2, defined by the presence of parasites and malarial pigment;
- Past infection was defined by the absence of parasites, but the presence of malarial pigment.

Statistical Data Analysis

All data collected were compiled on an Excel database (Microsoft, USA, 2021). Statistical analyses were performed using R software version 4.4.2. Categorical variables were summarized by relative and absolute frequencies. To measure the strength of the association, we calculated the odds ratio (OR) and its 95% confidence interval (CI). Logistic regression models were used to assess associations between various factors and placental malaria. The final model was selected using Akaike's information criterion (AIC) with a forward and backward approach. A p value < 0.05 was considered statistically significant.

Ethical Considerations

This study had been approved by the National Health Ethics Committee, under number 558/CNES/BN/PMMF/2024. Free and informed consent was obtained and an identifier was assigned to all participants at. The study was conducted in compliance with ethical principles and good clinical practice in accordance with the Declaration of Helsinki.

RESULTS

Socio-demographic Characteristics of Parturients

Table I shows that the average age of parturients was 28.9±6.4 years; the 20-34 age group was the most represented, with 70.2% of cases. Overall, parturients with secondary education were in the majority (66.3%), followed by illiterates (17.4%). Most parturients came from the commune of Dibindi (43.3%), followed by the commune of Kanshi (22.5%).

Clinical Profile of Parturients

According to Table II. Average parity was 4.3±2.7. Multiparous women were in the majority, with 68% of cases. In 83.7% of cases, pregnancies were at term, or gestational age (GA) between 37 and 41 WA, and 14.6% of parturients delivered prematurely (GA < 37WA). Over 46% of parturients had undergone at least

4 sessions of WHO-recommended ANC, while 7.9% had received no ANC at all. A history of fever during pregnancy was found in 72.5% of cases, while the diagnosis of malaria during pregnancy was certified in the records of 64% of parturients. Table III shows that LLIN was the measure most frequently used by parturients (68.5% of cases), but only 30% used it correctly. Intermittent preventive treatment with sulfadoxine-pyrimethamine was received in 41.6% of cases, but only 9.6% of parturients had received at least 3 doses.

Prevalence of Placental Malaria

Placentas from all 178 births during the study period were examined, with acute infection (category 1) found in 44 placentas (24.7%), chronic active infection (category 2) in 82 placentas (46.1%) and chronic past infection (category 3) in 28 placentas (15.7%), bringing the total number of infected placentas to 154 out of 178, for a prevalence of placental malaria of 86.5%. The prevalence of maternal malaria in peripheral venous blood was 32%.

Factors Associated with Malaria

According to Table IV, level of education is associated with placental malaria, with illiteracy multiplying the risk of placental malaria by 3 in a statistically significant manner (OR 3.22 [1.09 - 82.6] p=0.027), while a higher level of education proves protective (OR 0.01 [0.04 - 0.84] p= 0.002).

Table V shows an association between IPT-SP and placental malaria in univariate regression, with less than 3 doses down to 0 doses multiplying the risk of placental malaria by 8 (OR 8.06[2.69 - 24.1] p<0.001. According to Table VI, ANC was associated with placental malaria, with less than 4 sessions multiplying the risk by 31 (OR 31.7 [1.5 - 126] p= 0.034). Fever and malaria during pregnancy were also associated with placental malaria, multiplying the risk by 91 (OR 91.4 [8.33 - 306] p=0.002) and 124 (OR 124 [4.99 - 1645] p=0.016) respectively.

Table I. Parturients by socio-demographic characteristics

Features	**N = 178**[1]
Average age (years)	28,9 (6,4)
Brackets	
< 20	12 (6,7%)
20 - 34	125 (70,2%)
> 34	41 (23,0%)
Study level	
Illiterate	31 (17,4%)
Primary	22 (12,4%)
Secondary	118 (66,3%)
Superior	7 (3,9%)
Profession	
Housekeeper	87 (48,9%)
Self-employed	57 (32,0%)
Employee	34 (19,1%)
Municipality	
Dibindi	77 (43,3%)
Kanshi	40 (22,5%)
Muya	31 (17,4%)
Bipemba	19 (10,7%)
Excluding MBM	7 (3,9%)
Diulu	4 (2,2%)
[1]n (%); Mean (SD)	

Table II. Distribution of parturients by clinical features

Features	**N = 178**[1]
Average parity	4,3 (2,7)
Parity	
Multiparous	121 (68,0%)
Secondiparous	35 (19,7%)
Primiparous	22 (12,4%)
History of abortion	
Yes	50 (28,1%)
No	128 (71,9%)
Gestational age (WA)	
< 37	26 (14,6%)
37 - 41	149 (83,7%)
> 41	3 (1,7%)
Number of ANC	
No	14 (7,9%)
< 4	81 (45,5%)
≥ 4	83 (46,6%)
Fever during pregnancy	
Yes	129 (72,5%)
No	49 (27,5%)
Malaria in pregnancy	
Yes	114 (64,0%)
No	64 (36,0%)
[1]n (%); Mean (SD)	

Table III. Distribution of parturients according to antimalarial measures used

Features	**N = 178**[1]
Means of prevention	
MIILD	129 (72,5%)
Insecticides	37 (20,8%)
Medicinal plants	3 (1,7%)
No	12 (6,7%)
Number of nights on LLIN/week	
Less than 7 days	123 (69,1%)
Seven days	55 (30,9%)
TPISP	
Yes	74 (41,6%)
No	104 (58,4%)
Number of doses IPT-SP	
< 3	161 (90,4%)
≥ 3	17 (9,6%)
[1]n (%)	

Table IV. Logistic regression model identifying socio-demographic variables associated with placental malaria

	Bivariate analysis		Univariate regression			Multivariate regression		
Features	Yes (n=154[(1)])	No (n=24[(1)])	**OR**[2]	**95% IC**[2]	**p**	**OR**[2]	**95% IC**[2]	**p**
Average age (years)	28,8 (6,6)	29,5 (5,5)	0,98	0,92 - 1,05	0,6			
Ranges (years)								
20 - 34	106 (68,8%)	19 (79,2%)	-	-				
< 20	11 (7,1%)	1 (4,2%)	1,97	0,35 - 37,1	0,5			
> 34	37 (24,0%)	4 (16,7%)	1,66	0,58 - 6,00	0,4			
Education level								
Secondary	100 (64,9%)	18 (75,0%)	-	-		-	-	
Illiterate	30 (19,5%)	1 (4,2%)	5,40	1,05 - 99,1	0,11	3,22	1,09 - 82,6	**0,027**
Primary	21 (13,6%)	1 (4,2%)	3,78	0,72 - 69,8	0,2	0,19	0,00 - 369	0,8
Superior	3 (1,9%)	4 (16,7%)	0,14	0,02 - 0,66	**0,013**	0,1	0,04 - 0,84	**0,002**
Profession								
Liberal	50 (32,5%)	7 (29,2%)	-	-				
Housekeeper	74 (48,1%)	13 (54,2%)	0,80	0,28 - 2,09	0,7			
Employee	30 (19,5%)	4 (16,7%)	1,05	0,29 - 4,29	>0,9			
[1]Mean (SD); n (%)								
[2]OR = odds ratio, CI = confidence interval								

Table V. Logistic regression model identifying preventive measures associated with placental malaria

Features	Placental malaria		Univariate analysis			Multivariate analysis		
	Yes (154[1])	No (24[1])	OR[2]	95% IC[2]	p	OR[2]	% IC[2]	p
Mosquito netting								
No	48 (31,2%)	8 (33,3%)	-	-				
Yes	106 (68,8%)	16 (66,7%)	1,10	0,42-2,69	0,8			
Number of nights under mosquito net/week								
< 7 days	107 (69,5%)	16 (66,7%)	-	-				
7 days	47 (30,5%)	8 (33,3%)	0,88	0,36-2,30	0,8			
TPISP								
Yes	56 (36,4%)	18 (75,0%)	-	-		-	-	
No	98 (63,6%)	6 (25,0%)	5,25	2,07-15,2	<0,001	8,50	0,71-28	0,14
IPT-SP doses								
≥ 3	9 (5,8%)	8 (33,3%)	-	-				
< 3	145 (94,2%)	16 (66,7%)	8,06	2,69-24,1	<0,001			
[1]n (%)								
[2]OR = odds ratio, CI = confidence interval								

Table VI. Logistic regression model identifying clinical variables associated with placental malaria

Features	Placental malaria		Univariate analysis			Multivariate analysis		
	Yes (154[1])	No (24[1])	OR[2]	95% IC[2]	p	OR[2]	95% IC[2]	p
Average parity	4,2 (2,4)	5,2 (3,9)	0,88	0,76-1,03	0,10			
Parity								
Multiparous	106 (68,8%)	15 (62,5%)	-	-				
Secondiparous	32 (20,8%)	3 (12,5%)	1,51	0,46-6,81	0,5			
Primiparous	16 (10,4%)	6 (25,0%)	0,38	0,13-1,18	0,078			
History abortion								
No	117 (76,0%)	11 (45,8%)	-	-		-	-	
Yes	37 (24,0%)	13 (54,2%)	0,27	0,11-0,65	0,003	0,27	0,02-2,25	0,2
ANC								
No	11 (7,1%)	3 (12,5%)	-	-		-	-	
< 4	78 (50,6%)	3 (12,5%)	7,09	1,19-42,8	0,026	31,7	1,50-126	**0,034**
≥ 4	65 (42,2%)	18 (75,0%)	0,98	0,21-3,57	>0,9	0,81	0,05-13,2	0,9
Fever during pregnancy								
No	31 (20,1%)	18 (75,0%)	-	-		-	-	
Yes	123 (79,9%)	6 (25,0%)	11,9	4,58-35,2	<0,001	91,4	8,33-306	**0,002**
Malaria during pregnancy								
No	45 (29,2%)	19 (79,2%)	-	-		-	-	
Yes	109 (70,8%)	5 (20,8%)	9,20	3,46-29,1	<0,001	124	4,99-1645	**0,016**
Maternal malaria								
No	104 (67,5%)	16 (66,7%)	-	-				
Yes	50 (32,5%)	8 (33,3%)	0,96	0,39-2,51	>0,9			
[1]Mean (SD); n (%)								
[2]OR = odds ratio, CI = confidence interval								

DISCUSSION

Socio-demographic and clinical profile of the study population

The mean age of participants was 28.9± 6.4 years; our results corroborate those of Nkodo [18] and Modia [29]. The 20-34 age group was the most represented with 70.2% of cases. Overall, parturients with secondary education were in the majority (66.3%); our results differ from those of Ndesura, who reported the majority with primary education; educational backgrounds may explain these differences [25]. In Cardona's series, adolescents were the most numerous (61.6%) [17], whereas in our series like many other authors [22], it's more the multiparous; these results can be explained by the fact that generally parity is relative to age, especially in African environments, and that the

age range between 20 and 34 is that of active genital life. We found a history of abortion in 28.1% of parturients, revealing a frequent complication of malaria in the first trimester of pregnancy [30, 31] and 14.6% of parturients delivered prematurely (GA < 37WA), a frequent complication of placental malaria, especially in its active phase [30, 32]. More than 45% of parturients had reached at least 4 ANC sessions, our results are close to those of Mwin [22]. ANC is an important time to receive malaria control instructions. A history of fever during pregnancy was found in 72.5% of cases, and 64% of parturients had suffered from malaria during pregnancy. Our results are similar to those of Mwin and Ndessura [22, 25], as pregnancy makes women vulnerable to malaria, and fever is the main sign of this [33].

The majority of parturients had the insecticide-treated net, but only 30% used it correctly, and intermittent preventive treatment with sulfadoxine-pyrimethamine was present in 41.6%, but only 9.6% of parturients had received at least3 doses. In contrast to our results, over 97% of participants had used LLIN in Ndesura's series and around 60% in Mwin's series [22, 25]. Whereas IPT-SP was received with 2 doses in 52% and more than 3 doses in 31% of cases [22]. Availability and adherence to these preventive interventions and early and appropriate treatment of malaria are measures aimed at reducing malaria in pregnancy and placental malaria [26]

Prevalence of Placental Malaria

The prevalence of placental malaria was 86.5% in Mbujimayi, including 24.7% with acute infection, 46.1% with chronic active infection and 15.7% with past infection. In contrast to our study, some African authors have reported lower prevalences, ranging from 1.8% to 18.5% [21, 23, 32]; while others, such as Archange-Kimbi et al. in Cameroon, Umbers et al. in Guinea, Omer in Sudan, Ezebialu in Nigeria and Modia in Kinshasa, Democratic Republic of Congo, have reported results close to our own, ranging from 37.5% to 72% [29, 34, 36]. On the other hand, Bihoum Biébo's results (86.8%) in Burkina Faso corroborate our own [20].

These different results may be explained by the diagnostic techniques used, for example, microscopy (GE) is less sensitive for placental malaria [11], whereas histological examination is best indicated for the diagnosis of PP because in addition to detecting parasites, histology detects old lesions such as malarial pigment without parasites. Some studies have been carried out in women who had previously received regular IPT, whereas the rate of IPT was very low in our series, but also study environments or geographical areas have also contributed to these differences in results. Chronic active infection was in first place in our series, followed by acute and past infection. Past infection was the most prevalent (62.6%) in Bihoum's series, followed by chronic active infection (22.8%) [20]. Our results are similar to those of Ezebialu, with chronic active infection in first place [35]. These disparities may be explained by the fact that in environments with low plasmodium transmission there is low host immunity, triggering an inflammatory response and early delivery when the placenta is infected. Low exposure to Plasmodium also results in low placental parasitemia and a corresponding mild inflammatory response; whereas in areas of high endemicity there is placental hyperparasitemia with chronic, sometimes massive intervillositis and monocyte infiltration [8, 30].

Factors Associated with Placental Malaria

Logistic regression modeling showed that placental malaria was independently influenced by several factors, including the parturient's level of education and medical history. Thus, lack of education (illiteracy) and fewer ANC sessions than recommended by the WHO (4 ANC) proved to be predictive factors for placental malaria, they multiplied the risk of placental malaria by 3 (OR 3.22 [1.09 - 82.6] p=0.027) and by 31 (OR 31.7 [1.50 - 126] p=0.034), while a higher level of education was protective (OR 0.1 [0.04 - 0.84] p=0.002). Fever during pregnancy and history of malaria during pregnancy were factors associated with placental malaria.

In Omer's series, non-attendance at ANC was also reported as a risk factor for placental malaria (OR=11.9) [37]; our results are similar to those of Kalinjuli and De Beaudrap, reporting low educational level as a factor associated with placental malaria [21, 38]. In Mwin's series, less than 4 sessions of ANC multiplied the risk of placental malaria by 10 [22]. Several studies report fever and malaria infections during pregnancy as factors associated with placental malaria [25, 34, 38]. Peripheral parasitemia in early pregnancy can persist in the placenta throughout pregnancy, with potentially more serious consequences for the placenta and the newborn than an infection contracted later in pregnancy; peripheral infection increases the risk of placental malaria by a factor of five, and the risk of placental infection is higher if peripheral infection occurs early in pregnancy [30].

In univariate logistic regression, IPT increased risk of placental malaria by a factor of five; the efficacy of IPT-SP is currently controversial, with many studies reporting a benefit of IPT in the prevention of placental malaria, while others have found no significant influence of this means of prevention, which is nonetheless an inexpensive means of preventing complications linked to placental malaria. These differences may be explained by the emergence of P. falciparum resistance to sulfadoxine-pyrimethamine in highly endemic areas [23, 24, 39].

CONCLUSION

The prevalence of placental malaria is high in Mbujimayi, in contrast to the largely negative peripheral microscopy. Pregnant women's level of education and antenatal care are the main determinants. Fever during

pregnancy and malaria during pregnancy are indicators of placental malaria. What's more, coverage of IPT-PS remains low in our environment, despite the fact that it is an effective and, above all, inexpensive means of preventing placental malaria and the pregnancy complications that result from it. Faced with this reality, women's education and prenatal care must be encouraged, and pregnant women must be informed of any signs of malaria so that they can be treated early and correctly. In addition, the public authorities must optimize the care given to pregnant women, in particular by strengthening the activities of the National Malaria Control Program (NMCP) in the field.

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