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Prevalence of Gestational Malaria in Kisangani, Democratic Republic of Congo

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Abstract

Introduction: Gestational malaria is a major public health problem because it is a threat to pregnant women and their children. As Kisangani is a stable malaria transmission area and there is a paucity of data on the status of gestational malaria in our settings, we have found it appropriate to determine the prevalence of gestational malaria and its determinants in Kisangani City. **Methods:** We conducted a cross-sectional analytical study in Kisangani from January 1 to September 30, 2017. Our population study consisted of 1248 parturients recruited at delivery. We made the thick drop in peripheral blood from parturients at the admission and at the level of placental impressions after delivery. **Results:** The average age of the respondents was 25.3971 ± 6.2452 years; the overall prevalence of gestational malaria was 27.56% including 12.66% peripheral parasitaemia, 12.34% placental parasitaemia and 2.56% parasitaemia level and placental and peripheral blood impressions. Youngest age ≤ 18 years [OR (95% CI) = 2.44 (1.75 - 3.41), $p < 0.001$], primiparity [OR (95% CI) = 2.94 (2.00 - 4.32), $p < 0.001$] and positive HIV serology [OR (95% CI) = 3.01 (1.23 - 7.43), $p = 0.008$] increased the risk of gestational malaria; the use of mosquito net impregnated with insecticide [OR (95% CI) = 0.29 (0.14 - 0.61), $p < 0.001$] reduced this risk. **Conclusion:** The prevalence of gestational malaria is 27.56% in Kisangani. The youngest age ≤ 18 years, the primiparity and positive HIV serology of pregnant women were the most associated risk factors.

Keywords

Gestational Malaria, Thick Drop, Placental Imprint, Parasitaemia, Kisangani

1. Introduction

Malaria, known since ancient times, remains a public health problem. At the global level, in 2010 the population likely to be infected with the parasite and develop the disease was 3.2 billion, and the risk was high (more than 1 out of 1000 to contract malaria during one year) for 1.2 billion people [1].

After an unprecedented period of success in the global fight against malaria, the WHO reports that progress has stalled since 2014, and the evolution of malaria-related mortality is similar. In 2016, 216 million cases of malaria were reported in a total of 91 countries, an increase of 5 million over the previous year. The number of associated deaths reached 445,000, almost as in 2015 [2].

According to WHO, the African region still accounts for 90% of malaria cases and associated deaths worldwide [2]. Children under 5 and pregnant women are the main victims [3] [4]. Each year in Africa, more than 30 million pregnant women live in malaria endemic areas. The prevalence of malaria during pregnancy is variable in endemic areas. It varies from 5% to 40% depending on the country [5]. Malaria infestation of pregnant women is a major public health problem, as this disease is a threat to themselves and their children, with up to 200,000 newborn deaths each year due to the presence of malaria during pregnancy [6] [7].

The Democratic Republic of Congo (DRC) is the second most affected sub-Saharan African country after. These two countries alone, added to India, also account for 40% of malaria cases [8]. In northeastern DRC where Tshopo Province is located, malaria is the cause of consultation at 37% of all pathologies and the cause of death at 30% [9]. The equatorial feature which dominates this province in general and the city of Kisangani in particular, the presence of Plasmodium falciparum which ensures there an intense and permanent transmission as well as the unsanitary environment would be the cause. However, there is no data on the prevalence of gestational malaria in Kisangani.

Some factors make it difficult for Kisangani to control malaria among pregnant women. According to the National Malaria Control Program of the Eastern Province (DRC), these factors include late and irregular attendance of antenatal control (ANC) by pregnant women, as well as the shortage of sulfadoxine-pyrimethmine (SP) in care structures [4].

In view of the above, we conducted this study to determine the prevalence of gestational malaria and its determinants in the city of Kisangani.

2. Methods

We conducted a cross-sectional analytical study in 6 medical units in Kisangani city from January 1st to September 30th, 2017. We chose a medical training per commune, except for the commune of Makiso which had two and the commune of Kisangani which did not have any. This choice was motivated by the fact that they are first-level medical training and are very popular with pregnant women. As for the number of medical units in Makiso commune, this was due to two reasons: this commune is the commercial center of Kisangani which attracts

many pregnant women; and the second structure retained, the Kabondo General Reference Hospital (GRH), also receives pregnant women from Kisangani commune where there are no first-level medical units.

Data collection was prospective. The survey team consisted of twelve nurses or midwives (two per medical facility) and six laboratory technicians (one per structure). These nurses or midwives had attended training sessions in order to standardize the interview procedure. Laboratory technicians were briefed on techniques for peripheral blood sampling and placental fingerprinting, spreading, and specimen routing as directed by the National Malaria Control Program.

We recruited in an exhaustive way all the parturients admitted in the medical structures selected during our period of study. To be included, these parturients should not have a history of taking antimalarial in the two weeks preceding delivery, or come from an environment other than Kisangani and its surroundings (more than 30 km) for less than 14 days before delivery. Also excluded were parturients whose sample was not examined because of a poor process of spreading and those who did not consent to the study (Figure 1).

On admission to the work-room, the nurses or midwives interviewed the parturients, after informed consent for participation in the study and the investigations, to find their socio-anthropometric parameters, their antecedents and means of fight against malaria. The interview was followed by a complete physical examination of these parturients. After the physical examination, the laboratory technicians had collected a blood sample from a maternal peripheral vein and proceeded to the preparation of tick dropand thin smear. They then performed the rapid HIV test for all parturients who consented and were not screened during pregnancy. The positive test was then confirmed at the Provincial Laboratory of the national AIDS program.

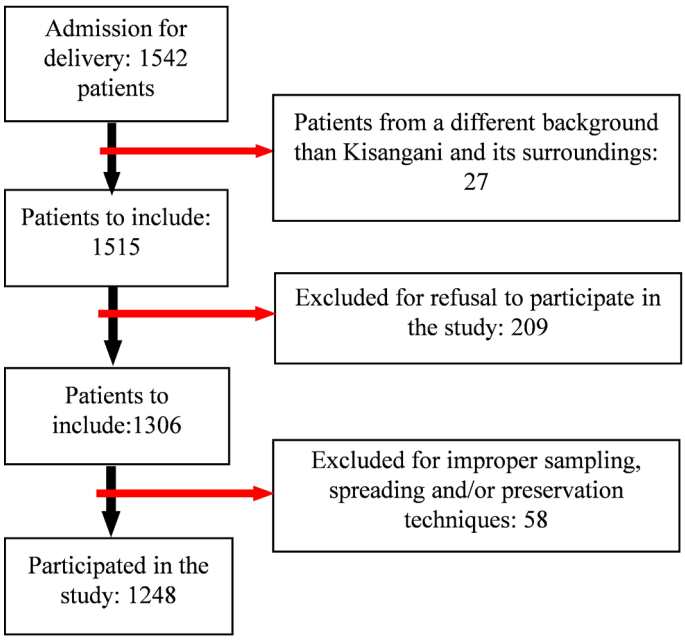

Figure 1. Flowchart.

After delivery, laboratory technicians removed the placental imprints from the maternal side of the placenta, 1 cm from the umbilical cord insertion, and proceeded with the preparation of tick drop and thin smear. Reading of tick dropand thin smear was done at the Provincial Public Health Laboratory (PPHL).

For the quality-assurance of results produced by the PPHL, 125 random samples were transferred and analyzed at the national institute of biomedical research in Kinshasa. Analytical results from two laboratories were compared using Kappa's concordance analysis. In total, the agreement between the results obtained was strong (k = 0.6168).

In our analysis, any parturient in whom tick drop was positive in the peripheral blood and/or in the placental imprint was considered a "case of gestational malaria".

The collected data were encoded in Excel and imported for analysis using Epi Info version 7.1 and Xlstat 2015 software. For the description of the sample, we calculated the frequency and the percentage as well as the averages and their standard deviations (SD). To compare proportions, we calculated Pearson's chi-squared at the significance level $p < 0.05$. When the Pearson chi-square application conditions were not satisfactory, we used Fisher's exact test at <0.05. To measure the strength of the association, we calculated the odd ratio (OR) and its 95% confidence interval (CI).

3. Results

3.1. General Characteristics of the Respondents

The mean age of our respondents was 25.40 ± 6.24; 170 respondents (13.62%) were under 18 years of age while 128 respondents (10.26%) were 35 or older; 25.32% of our respondents were primiparous; 24.36% were primigest; 95.03% of them used the mosquito net impregnated with insecticide (MII); the proportion of respondents with positive HIV serology was 3.37% (Table 1).

3.2. Prevalence of Gestational Malaria

Of the 1248 patients included in our study, 344% or 27.56% had gestational malaria. Of these, 12.66% had a thick positive blood drop in the peripheral blood, 12.34% in the placental impressions and 2.56% in the placental impressions and in the peripheral blood.

3.3. Gestational Malaria According to the Socio-Demographic Characteristics of Parturients

Age of parturients was a risk factor for gestational malaria. Indeed, the youngest age ≤ 18 years multiplied by 2.4 the risk of gestational malaria ($p < 0.001$) whereas an age greater than or equal to 35 significantly reduces this risk. Educational attainment and residence did not influence this risk, whereas the informal sector as a pregnant occupation protected it from this risk [OR (95% CI) = 0.44 (0.23 - 0.83); p = 0.0093] (Table 2).

3.4. Gestational Malaria According to the History of Parturients and Means of Prevention

With respect to the history of parturients, primiparity and primigestity were associated with an increased risk of gestational malaria of 2.94 times, respectively [OR (95% CI) = 2.94 (24 - 3.86); p < 0.001] and 2.86 times [OR (95% CI) = 2.86 (2.17 - 3.76); p < 0.001]; the same is true for HIV positive serology, which increased the risk by 3.01 [OR (95% CI) = 3.01 (1.62 - 5.60); p < 0.001]. On the other hand, follow-up of antenatal control (ANC) and Sulfadoxine-Pyrimethamine (SP) did not influence the risk of gestational malaria [OR (95% CI) = 0.82 (0.48 - 1.42); p = 0.2493] while use of MII significantly reduced this risk [OR (95% CI) = 0.29 (0.17 - 0.48); p < 0.001]. The number of ANC [OR (95% CI) = 0.92 (0.71 - 1.19); p = 0.2788] and the number of doses of SP [OR (95% CI) = 0.00 (0.00 - 9.22); p = 0.5274] did not influence the risk of gestational malaria (Table 3).

3.5. Maternal Fever during Labor and Gestational Malaria

Of 26 respondents who had fever, 20 (76.92%) had gestational malaria. Fever increased susceptibility to positive parasitaemia by 9.22 times [OR (95% CI) = 9.22 (3.79 - 25.30); p < 0.001], as shown in Table 4 of our study.

Table 1. Characteristics of the respondents.

Characteristics	Frequency (n = 1248)	Percentage	95% CI
Age (average ± SD = 25.3971 ± 6.2427)			
≤18	170	13.62	11.79 - 15.68
19 - 34	950	76.12	73.64 - 78.44
≥35	128	10.26	8.66 - 12.11
Level of education			
Superior	154	12.34	10.59 - 14.32
Secondary	890	71.31	68.70 - 73.79
Primary	174	13.94	12.09 - 16.02
Illiterate	30	2.40	1.66 - 3.46
Profession			
Pupil/student	84	6.73	5.43 - 8.30
whithout	1050	84.13	81.96 - 86.09
Salaried	34	2.72	1.92 - 3.83
Informal sector	80	6.41	5.14 - 7.95
Residence			
Rural	192	15.58	13.45 - 17.53
Urban	1056	84.62	82.47 - 86.55
Medical structure			

Continued

*RHC Foyer	314	25.16	22.79 - 27.68
RHC Matete	334	26.76	24.34 - 29.33
RHC Saint-Joseph	178	14.26	12.39 - 16.35
GRH Kabondo	202	16.19	14.21 - 18.37
GRH Lubunga	128	10.26	8.66 - 12.11
GRH Makiso	92	7.37	6.01 - 9.00
Parity (Average ± SD = 2.0962 ± 1.9888)			
Multiparous	932	74.68	72.15 - 77.05
Primiparous	316	25.32	22.95 - 27.85
Gravidity (Average ± SD = 3.3830 ± 2.2296)			
Multigest	944	75.64	73.14 - 77.98
Primigest	304	24.36	22.02 - 26.86
ANC (Average ± SD = 3.0865 ± 1.2614)			
0	80	6.41	5.14 - 7.95
1	60	4.81	3.72 - 6.18
2	160	12.82	11.04 - 14.83
3	442	32.77	32.77 - 38.15
4	384	30.77	28.23 - 33.43
5	122	9.7	8.21 - 11.59
Doses of SP administered (Average ± SD = 2.5849 ± 0.8528)			
0	80	6.41	5.14 - 7.95
1	60	4.81	3.72 - 6.18
2	160	12.82	11.04 - 14.83
3	947	75.80	73.31 - 78.13
4	2	0.16	0.03 - 0.64
Use of MII			
No	62	4.97	3.86 - 6.36
Yes	1186	95.03	93.64 - 96.14
HIV serology			
Negative	1206	96.63	95.44 - 97.53
Positive	42	3.37	2.47 - 4.56

RHC: Reference Health Center.

Table 2. Prevalence of gestational malaria according to the socio-demographic characteristics of parturients.

	Gestational malaria		p-Value	OR (95% CI)
	Negative (%)	Positive (%)		
Age				
≤18 years	94 (55.29)	76 (44.71)	<0.001	2.44 (1.75 - 3.41)
19 - 34 years	696 (73.26)	254 (26.74)	0.2429	0.84 (0.63 - 1.12)
≥35 years	114 (89.06)	14 (10.94)	<0.001	0.29 (0.17 - 0.52)

Continued

Level of education				
Superior	102 (66.23)	52 (33.77)	0.0658	1.40 (0.97 - 2.00)
Secondary	654 (73.48)	236 (26.52)	0.1917	0.83 (0.63 - 1.09)
Primary	128 (73.56)	46 (26.44)	0.7197	0.93 (0.65 - 1.34)
Illettrate	20 (66.67)	10 (33.33)	0.4740	1.32 (0.61 - 2.85)
Profession				
Pupil/student	58 (69.05)	26 (30.95)	0.4717	1.19 (0.73 - 1.92)
whithout	756 (72)	294 (28)	0.4274	1.15 (0.81 - 1.62)
Salaried	22 (64.71)	12 (35.29)	0.3064	1.44 (0.70 - 2.96)
Informal sector	68 (85.00)	12 (15.00)	0.0093	0.44 (0.23 - 0.83)
Residence				
Rural	138 (71.88)	54 (28.12)	0.4219	0.96 (0.68 - 1.36)
Urban	766 (72.54)	290 (27.46)	1	

Table 3. Prevalence of gestational malaria based on history of parturients and ways to prevent malaria.

	Gestational malaria		OR (95% CI)	p-Value
	Negative (%)	Positive (%)		
Parity				
Primiparous	174 (55.06)	142 (44.94)	2.94 (2.24 - 3.86)	<0.001
Multiparous	730 (78.33)	202 (21.67)	1	
Gestity				
Primigest	168 (55.26)	136 (44.74)	2.86 (2.17 - 3.76)	<0.001
Multigest	736 (77.97)	208 (22.03)	1	
ANC follow-up				
No	44 (68.75)	20 (31.25)	0.82 (0.48 - 1.42)	0.2493
Yes	859 (72.61)	324 (27.39)	1	
Number of ANC				
1 - 3	488 (71.98)	190 (28.02)	0.92 (0.71 - 1.19)	0.2788
≥4	372 (73.52)	134 (26.48)	1	
Taking SP				
No	44 (68.75)	20 (31.25)	0.82 (0.48 - 1.42)	0.2493
Yes	859 (72.61)	324 (27.39)	1	
Doses of SP administered				
1 - 3	858 (72.59)	324 (27.41)	0.00 (0.00 - 9.22)	0.5274
≥4	2 (100.00)	0 (0.00)	1	
HIV serology				
Positive	20 (47.62)	22 (52.38)	3.01 (1.62 - 5.60)	<0.001
Negative	884 (73.30)	322 (26.70)	1	
Use of MII				
No	28 (45.16)	34 (54.84)	0.29 (0.17 - 0.48)	<0.001
Yes	876 (73.86)	310 (26.14)	1	

Table 4. Prevalence of gestational malaria in relation to maternal fever during labor.

	Gestational malaria			
	Negative	**Positive**		
Maternal fever	**Frequency (%)**	**Frequency (%)**	**OR (95% CI)**	**p - Value**
Non	898 (73.49%)	324 (26.51%)	1	<0.001
Oui	6 (23.08%)	20 (76.92%)	9.22 (3.79 - 25.30)	

4. Discussion

4.1. Prevalence of Gestational Malaria

In this study, the overall prevalence of gestational malaria in Kisangani was 27.56%. This prevalence is higher than those found by Filbert *et al.* [10] in Tanzania (19.49%, 95% CI = 15.73 - 23.24) and by Olga *et al.* [11] in northwestern Colombia (9.1). It is also higher than the figure found by Lukuka *et al.* [12] (21%) in four maternity hospitals in the city of Kinshasa in the DRC in 2005. It is however lower than that found by Omolola *et al.* [13] in Nigeria.

Parasitaemia in peripheral blood was positive in 15.22% of cases in our series. In India, Davidson *et al.* [14] found that among women who gave birth, 1.7 (12/717) had peripheral parasitaemia. Neeru *et al.* [15], Judith *et al.* [16] and Valérie Briand *et al.* [17] found peripheral parasitaemia of 2.8% in Bastar, 5.6% in Cameroonian parturients and 5.9% in southern Laos, respectively.

The proportion of patients with peripheral parasitaemia was 25.8% in rural Burkina Faso [18], 27% in Uganda [19] and 29.7% in Geita district (northwestern Uganda, Tanzania) [10]. Parasitaemia in placental impressions was positive in 14.90% of cases. Davidson *et al.* [14] had found 2.4% of cases, Olga *et al.* [11] 3.3% of cases; Sanata *et al.* [18] 4.7% of cases.

The prevalence found in our study is however lower than those found by Judith *et al.* [16] (25.5%), Filbert *et al.* [10] (37.6%) and Ifeanyichukwu *et al.* [20] (69.6%).

We believe that the high prevalence of gestational malaria in our country is due to the fact that we are in a stable transmission zone of plasmodium. The difference with the study conducted in Kinshasa by Lukuka *et al.* [12] is due to the fact that Kinshasa has a lower rainfall than Kisangani. Similarly, the 2013-2014 Demographic and Health Surveys reported that prevalence is higher in Eastern Province than in Kinshasa [21]. In addition, this stability in plasmodium transmission explains the high proportion of placental parasitaemia in our series, compared to areas of unstable transmission.

4.2. Prevalence of Gestational Malaria According to Socio-Demographic Characteristics of Parturients

- ***Age of parturients***

We found that the youngest age ≤ 18 years was one of the risk factors for gestational malaria (P < 0.000) while an age greater than or equal to 35 years significantly reduced this risk. This result is consistent with those of Samia *et al.* [22]

[OR (95% CI) = 3.2 (1.9 - 5.5); p < 0.001], Omolola *et al.* [13] (29.4 vs 27.7 years, p = 0.001), Judith *et al.* [16] [OR (95% CI) = 4.61 (1.47 - 14.70)] and Pierre De Beaudrap *et al.* [19]. In fact, gestational malaria is more prevalent among the younger parturients who have not yet acquired sufficient protection against malaria, unlike parturients over 35 years of age.

- ***Residence***

In our series, the residence of the parturient did not influence the risk of gestational malaria [OR (95% CI) = 0.96 (0.68 - 1.36); p = 0.4219]. As for our study, in the study of Samia *et al.* [22] the residence was not associated with placental malaria in Sudanese women in Blue Nile State. On the other hand, Davidson *et al.* [14], Pierre De Beaudrap *et al.* [19] and Ifeanyichukwu *et al.* [20] found that rural residence was significantly associated with placental malaria.

We think that this difference would be related to the unsanitary environment. The urban areas of Kisangani are currently very dirty, mixed with rural areas, with many water collections that favor the development of Anopheles larvae.

4.3. Gestational Malaria According to the History of Parturients and Means of Prevention

- ***Parity and Gestity***

This study made it possible to objectify that primiparity [OR (95 CI) = 2.94 (2.24 - 3.86); p < 0.001] or primigestity [OR (95 CI) = 2.86 (2.17 - 3.76); p < 0.001] each increased by about 3 times the risk of malaria-induced pregnancy.

This joins the results of Samia *et al.* [22] and Mamoudou *et al.* [23] who had found that primiparity was the risk factor for placental malaria with respectively. Indeed, for Samia *et al.* [22] primiparity increased the risk of placental malaria by approximately 4-fold [OR (95% CI) = 3.9 (2.1 - 7.6); p < 0.001]; for Mamoudou *et al.* [24] the risk was 5 times [OR (95% CI) = 5.0 (2.5 - 9.8)]. Ifeanyichukwu *et al.* [20] found that placental density of Plasmodium was inversely related to parity.

As for gestationality, our result matches those of Omolola *et al.* [OR (95% CI) = 2.5 (1.5 - 4.2)] [13] and Valérie Briand *et al.* [OR (95% CI) = 3.17 (1.32 - 7.61)] [17] who found that primiparity increased the risk of gestational malaria. These results are explained by the phenomenon of placental sequestration of plasmodium, which is more common in primigest. Indeed, despite her premunition, her previously acquired immunity, a woman becomes susceptible to malaria infection during her first pregnancy when chondroitin sulfate A binding parasites encounter the placenta, as this parasite population has a modification of the antigenic determinants allowing it to escape the immune surveillance of the host. The latter develops the antibodies against this parasitic population only during subsequent pregnancies.

- ***Antenatal control***

In our series, follow-up of ANC did not influence the occurrence of gestational malaria [OR (95% CI) = 0.82 (0.48 - 1.42); p = 0.2493]. This result differs from that of Neeru *et al.* [15] who had found a low prevalence of peripheral parasi-

taemia among pregnant women who had followed ANC, as well as Samia *et al.* [22] who reported that non-attendance of ANC increased the risk of gestational malaria by almost 12 times [OR (95% CI) = 11.9 (7.8 - 18.1); p < 0.001]. Judith *et al.* [16] found a high incidence of microscopic parasitaemia at delivery in pregnant women who started third-trimester ANC and who received only one dose of SPcompared with two-dose.

- ***Intake and number of doses of Sulfadoxine-Pyrimethamine administered***

We found that taking Sulfadoxine-Pyrimethamine did not influence the risk of gestational malaria [OR (95% CI) = 0.82 (0.48 - 1.42); p = 0.2493].

Mamoudou *et al.* [23] found that the use of intermittent malaria prophylaxis for SP was not associated with malarial P. falciparum infestation. In contrast, compared to women who did not receiveintermittent malaria prophylaxis, Pierre *et al.* [19] found that pregnant women who received one or two doses experienced a five or tenfold reduction, respectively, in the risk of malaria infection [RRa (95% CI) = 0.20 (0.14 - 0.30) and 0.10, (95% CI) = (0.06 - 0.18)].

In our series, the number of doses of SP [95% OR IC = 0.00 (0.00 - 9.22); p = 0.5274] did not influence the risk of gestational malaria. This result does not agree with those of Filbert *et al.* [10], Sanata *et al.* [18] and Kimberly *et al.* [24] who reported that the prevalence of gestational malaria decreased with the number of intermittent preventive treatment doses.

We believe that MS does not provide enough protection for this series of anti-malarial drugs. This would be due to the inefficiency of this molecule or to the resistance of plasmodium.

- ***Use of MII***

In our series, the use of MII reduced the risk of gestational malaria by 0.29 [OR (95% CI) = 0.29 (0.17 - 0.48); p < 0.001].

Our result matches those of Ifeanyichukwu *et al.* [20], Pierre *et al.* [19] and Samia *et al.* [23] [OR (95% CI) = 3.5 (1.7 - 6.8); p < 0.001]. On the other hand, it is reversed by Valérie *et al.* [17] who reported in their study that all infected women reported sleeping under a net bed the day before the survey.

We believe that the MII remains an effective means for the prevention of gestational malaria, especially through its repellent effect. However, the time that pregnant women spend outside before sleeping under the MII exposes them to mosquito bites and that to malaria.

- ***HIV serology***

Positive HIV serology increases 3.01 times the risk [OR (95% CI) = 3.01 (1.62 - 5.60); p < 0.001]. Our result is consistent with that of Pierre *et al.* [19].

One of the major reasons advanced to explain the susceptibility of HIV-positive women to malaria is the cytokine-induced deregulation caused by HIV and the lack of protective response by IFN-γ. Loss of IFN-γ response in HIV-positive pregnant women, especially after antigenic stimulation of P. falciparum, may impair their ability to control malaria infection. In addition, the substantial loss of mononuclear cell production of placental intervillosities of IL-12, but not IL-18, or IFN-γ inducible protein-10 (IP-10), is observed in

women with HIV and *P. falciparum* co-infection. The consequence of this deterioration is the increase in susceptibility to malaria by pregnant women [25].

- ***Maternal fever during labor and gestational malaria***

Fever increased 9.22 times the susceptibility to positive parasitaemia [OR (95% CI) = 9.22 (3.79 - 25.30); $p < 0.001$]. Our results corroborate those of Davidson *et al.* [14] and Judith *et al.* [16] who found that the fever increased by 5.34 times [RR (95% CI) = 5.34 (2.89 - 9.90)] and 2.98 times [OR (95% CI) = 2.98 (1.58 - 5.73)] the risk of detecting parasitaemia under the microscope. This justifies the fact that malaria is the most frequent febrile illness in sub-Saharan Africa.

5. Conclusion

The prevalence of gestational malaria in Kisangani, at 27.56%, is enormous. The youngest age ≤ 18 years, primiparity and primigestity, as well as the positive HIV status of gestants, are the determining factors. The use of MII reduces this risk. Maternal fever increases the risk of detection of parasitaemia under a microscope, hence the importance of always thinking about gestational malaria in pregnant women who have fever in our environment. The dose and number of doses of SP did not influence the risk of gestational malaria. Several reasons have been mentioned to explain this fact, in particular the possible inefficiency of this molecule or the probable resistance of the plasmodium. In order to reduce the prevalence of gestational malaria in our environment, a study comparing the efficacy of SP with that of another molecule for intermittent malaria prophylaxis should be conducted.

Ethical Considerations

Before conducting this study, the study protocol was approved by the ethics committee of Kisangani University. The special authorizations were obtained from the staff of the Department of Gyneco-Obstetrics and the Decanal Authorities of the Faculty of Medicine and Pharmacy of the University of Kisangani, and the heads of the selected medical units. Informed consent was previously obtained from pregnant women before being selected for the study. In all the pregnant women included in the study, and in whom peripheral or placental parasitaemia was positive, antimalarial treatment was administered according to the recommendations of the National Malaria Control Program in DRC

Contributions of the Authors

Dr. Labama conceived the protocol and wrote the manuscript. Doctors Labama and Bosenge were responsible for collecting the data. Doctors Bosenge and Maindo coded and processed the data and contributed to thereview of literature. Professors Modia, Katenga and Likwela had corrected the protocol and enriched the manuscript. Professor Manga had corrected the protocol, validated the research and enriched the manuscript. All authors have validated the final version

of the manuscript.

Conflict of Interest

The authors state that they have no conflict of interest.

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