

Intermittent Preventive Treatment and Malaria of Parturient Women in Southeastern Gabon.

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Research

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Abstract

Background: Evaluating malaria control strategies for pregnant women is essential. The objective of this study was to determine the factors influencing the frequency of prenatal consultations (PNC), the adherence to intermittent preventive treatment with sulfadoxine-pyrimethamine (IPT-SP) and its impact on the health of parturient women and their newborn babies living in semi-urban and rural areas of southeastern Gabon.

Methods: This transversal study was performed at the *Centre Hospitalier Régional Paul Moukambi de Koula-Moutou* (CHRPMPK). Information regarding age, frequency of prenatal consultations, obstetric history, use of malaria control measures, use of IPT-SP, malaria diagnostic of parturient women and their newborns, were collected with a questionnaire and from birth registers from January 1st 2018 to December 31st 2019.

Results: In total, 2174 parturient women were included in the study. The mean age was 26.2 ± 6.99 years and 81.4% of parturient women attended at least four CPN. The proper attendance of PNC (at least 4 prenatal consultations) was linked with age ($p < 0.001$) and profession (aOR= 1.72 [1.27 - 2.37]; $p < 0.001$). The coverage rate of IPT-SP was 90% with a good adherence rate (at least three doses of IPT-SP) of 58.87%. The good adherence rate to IPT-SP was linked to profession (aOR= 1.65 [1.20 - 2.29]; $p < 0.01$) and age ($p < 0.001$). The mean weight of newborns was higher for babies whose mothers had received three doses of IPT-SP ($p < 0,001$) but the APGAR score was not influenced by the use of IPT-SP by the mother ($p = 0.47$). The prevalence of plasmodial infection was 3.10% ($IC_{95\%} = [1.21 - 5]$) and *Plasmodium falciparum* was responsible for 100% of infections. The prevalence of plasmodial infection was the same for all age groups ($p > 0.06$). No link was found between plasmodial infection, gravidity ($p > 0.06$) and domestic control measures ($p \geq 0.05$). A low birth weight was statistically linked to the mother's plasmodial infection (OR= 9.42 [2.55 – 34.75]; $p < 0.01$). Furthermore, plasmodial infection was statistically linked to premature birth (OR= 69.25 [8.52 – 562.69]; $p < 0.001$).

Conclusions: We observed a good attendance of women to prenatal counselling services in southeastern Gabon, though the adherence of IPT-SP is insufficient.

Background

Malaria is a public health issue and approximately half of the population in the world is exposed. Malaria is particularly severe in tropical areas where *Plasmodium falciparum* is found. Plasmodial infection essentially results in severe and sometimes lethal febrile symptoms. Pregnant women are one of the most vulnerable populations because of their compromised immune system due to pregnancy. In order to fight malaria in pregnant women, the World Health Organization (WHO) recommends a threefold approach: vector control through the use of long-lasting insecticidal nets (LLINs), the use of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPT-SP) which has a protective effect in the mother and fetus, and finally, the early diagnostic of all suspect cases in order to initiate care [WHO, 2020].

In Gabon, malaria transmission is perennial due to its warm and humid equatorial climate which favors the proliferation of mosquitos. In order to fight malaria, the country has adopted WHO recommendations since 2003. These measures have led to a significant decrease of infection, especially in the most vulnerable subjects (children aged less than five years old and pregnant women) [1, 2].

Previous studies on malaria in pregnant women in Gabon have shown that malaria prevalence in the capital Libreville and its surrounding areas was 34.4%, 53.6% and 18.2% in maternal peripheral blood, placenta and umbilical cord, respectively. In addition, adherence to IPT-SP was associated with the decrease of plasmodial infection in pregnant women, and to the prevention of premature birth and low birth weight [3]. The adherence of pregnant women to IPT-SP reaches 80% in urban areas, with a good adherence rate of 57.4% (at least three doses of IPT-SP) [4].

Furthermore, a recent study in Fougamou [5], a semi-urban area in central Gabon, showed that 94.4% and 47.9% of parturients received one and at least three doses of IPT-SP, respectively, during pregnancy and that the prevalence of *P. falciparum* infection was 11.7%. In the same study, Fleuramie et al. showed that prevalence of plasmodial infection was the same whatever the number of doses of IPT-SP received by pregnant women. However, no data are available for semi-urban and rural areas in southeastern Gabon [6].

Thus, the objective of this study is to determine the frequency of prenatal consultations (PNC), the adherence to IPT-SP and its impact on the health of newborn babies in semi-urban and rural areas in southeastern Gabon.

Materials And Methods

Study Site And Patients

This study was conducted at the maternity ward of the Centre Hospitalier Régional Paul Moukambi de Koula-Moutou (CHRPMPK) in the Ogooué-Lolo province, Gabon. This cross-sectional descriptive study involved all pregnant women who gave birth at the hospital.

Sampling

Socio-demographic, clinical and paraclinical data of all parturient women, as well as the birth information of their newborn babies were collected: (i) from birth registries dated from January 1st, 2018 to December 31st, 2019; (ii) with a questionnaire from January 1st to April 30, 2020, filled and signed by the investigator and the parturient woman or the parent/legal guardian for minors, after informed consent. Additional information such as knowledge of parturient women on malaria, the presence or absence of window screens in their homes, the use of insecticide, ventilation means and the use of long-lasting insecticidal nets (LLINs) were collected via the questionnaires. The mosquito net was considered treated with insecticide when it was obtained less than 6 months ago. Malaria diagnosis was performed for all

parturient women who came to the hospital from January 1st to April 30, 2020 using the Lambaréné method [7].

In accordance with WHO recommendations, were considered as "bad attendance" and "good attendance" of antenatal care if parturients had consulted "less than four times" and "at least four times" respectively during pregnancy. Also, was considered "bad adherence" and "good adherence" to IPT-PS, parturients who had taken "less than three (<3) doses" and "at least three (≥ 3) doses" of IPT-PS, respectively. APGAR score and neonatal birth weight were described as elsewhere [8–10].

Statistical Analyses

Data of parturient women were recorded in Excel 2013 spreadsheets. Statistical analysis was performed using the Epi-Info 6 and R version 4.0.5 (2021-03-31) software. Proportion and mean of qualitative variables, standard deviation, median and inter-quartile range (IQR) were recorded. The proportions of qualitative variables were compared using the Chi-square test. Fisher's exact test was used for numbers below 5. Mean values were compared with Student's *t* test, with the ANOVA test to compare more than two means or the nonparametric Kruskal-Wallis test when numbers were insufficient. The Crude (OR) and adjusted odds ratios (aOR) are presented, the confidence interval was set at 95 % (IC_{95%}). Statistical significance was set at $\alpha = 5\%$.

Results

Sampling description

In total, the data of 2174 parturient women was collected: 1851 from birth registries and 323 from pregnant women enrolled in the survey carried out from January 1st to April 30, 2020. The proportion of Gabonese women or women of foreign nationality were, respectively, 95.58% (IC_{95%} = [94.87 - 96.57]) and 4.42% (IC_{95%} = [3.45 - 5.15]). Ninety-percent (90%, 1953 women) of parturient women were unemployed and ten percent (10%, 223 women) had an occupation or income-generating activities. The majority of women (97.70%) lived in the semi-urban regions of Koula-Moutou and Lastourville. The remainder (1.8%) lived in rural villages. The mean age was 26.2 ± 6.99 years, the median was 25 years (IQ = [20 - 31]). The rate of parturient women with health insurance (National Health Insurance Fund) was 80.31%.

Figure 1. Distribution of parturient women according to age group.

Parturient women aged 12 to 17 years represented 6.7% (145/2174) of deliveries and 96.55% (140/145) were primiparous. The average gestation period was 38.4 ± 2.04 weeks. The percentage of parturient women according to their obstetric history (gravity and parity) are presented in Table 1.

Table 1
Distribution of parturient women according to their obstetric history.

History	History	Number (%)
Gravidity (G*)	Primigravida ($1 \leq G \leq 3$)	1196 (55)
	Multigravida ($3 < G < 6$)	647(30)
	Grand multigravida ($G \geq 6$)	331(15)
Parity (P**)	Primipara ($0 \leq P < 3$)	1351(62.4)
	Multipara ($3 \leq P < 6$)	614(28)
	Grand multipara ($P > 6$)	209(9.6)
G* Number of Pregnancy		

P** number of deliveries

The rates of preterm, term and post-term births for parturient women were, respectively, 12.68% (n= 217), 85.25% (n= 1860) and 2.07% (n= 217).

Prenatal Consultations And Intermittent Preventive Treatment

Parturient women attended on average 3.63 ± 1.46 PNC with a median of 4 PNC (IQ= [3 - 5]), a minimum of 0 and a maximum of 8 (Figure 2). The rate of attendance to prenatal care was 40% for parturient women aged 12 to 17 years and 57.55% for women aged more than 18 years. Proper attendance to prenatal care (at least 4 PNC) was observed in 55.11% (1198/2174) of pregnant women. The rate of proper attendance to prenatal care was 53.46% for unemployed women and 66.09% for those with an occupation. In primigravida, multigravida, and grand multigravida women, the rate of prenatal care attendance was 53.30%, 59.41% and 52.87, respectively.

Figure 2. Attendance to PNC and treatment with IPT-SP.

Ninety percent (1956/2174) of parturients had received at least one dose (global rate of IPT-SP coverage) and 19% (42/218) of parturients women who received no dose of IPT-SP attended PNC properly. A good adherence rate (at least three doses of IPT-SP) was observed in 58.87% ($IC_{95\%} = [56.80 - 60.93]$) of pregnant women. Among these, 72.20% (161/223) had an occupation, 57.30% (1119/1953) were unemployed, and 55.72% (667/1197), 63.27% (410/648) and 61.33% (203/331) were primigravida, multigravida and grand multigravida, respectively. Moreover, the rate of good adherence to IPT-SP was 43.45% (63/145) for parturient women aged 12 to 17 years, 55.85% (444/795) for women aged 18 to 23 years, 57.98% (316/545) for women aged 24 to 29 years, 69.59% (302/434) for women aged 30 to 35

years, 61.40% (132/215) for women aged 36 to 41 years and 54.76% (23/42) for women over the age of 42.

Characteristics Of Newborns

In total, 2239 children were born, 1125 males (50.3%) and 1114 females (49.7%) with a sex ratio (M/F) of 1.01. The average weight of newborns was 2991.7 ± 518.9 g, with a minimum of 750g and a maximum of 4900g. The rates of newborns with a « normal » birth weight, hypotrophy and macrosomia, were 84.5% ($IC_{95\%} = [83 - 86]$), 13.8% ($IC_{95\%} = [12.37 - 15.23]$) and 1.7% ($IC_{95\%} = [1.16 - 2.24]$), respectively. Among the total number of newborns, 1918 babies (86%) had an excellent APGAR score (10/10), 208 (3.2%) had a good APGAR score, 72 (3.9%) had a low APGAR score and 41 babies (1.8%) suffered from birth asphyxia.

Impact of age group on PNC attendance and adherence to IPT-SP. Our analyses showed a statistical link between age groups and proper attendance to prenatal care ($p < 0.001$), as well as between age groups and good adherence to IPT-SP ($p < 0.001$). The [12–17] age group was the least likely to attend antenatal care services and had lower adherence to IPT-PS contrary to the [30–35] age group.

Impact of profession on PNC attendance and adherence to IPT-SP. Parturient women with an occupation had a PNC attendance 1.94 times higher than unemployed pregnant women (OR= 1.94 [1.43 – 2.65]; $p < 0.001$). Similarly, adherence to IPT-SP was 1.94 times higher for parturient women with an occupation (OR= 1.94 [1.43 – 2.64]; $p < 0.001$).

Impact of obstetric history on PNC attendance and adherence to IPT-SP. Univariate analysis showed that proper PNC attendance ($p = 0.03$) and good adherence to IPT-SP ($p < 0.01$) were linked to the obstetric history of pregnant women (gravidity).

Impact of residence on PNC attendance and adherence to IPT-SP. Parturient women living in semi-urban and rural areas both had the same attendance rate to PNC ($p > 0.05$) and the same adherence rate to IPT-SP ($p > 0.05$).

Table 2

Multivariate analysis of factors associated with proper PNC attendance and good adherence to IPT-SP.

	PNC	<i>p</i>	IPT-SP	<i>p</i>
	aOR [IC _{95%}]		aOR [IC _{95%}]	
Age group (in years)				
[18–23] vs [12–17]	1.67 [1.17 - 2.40]	< 0.01	1.63 [1.14 - 2.33]	< 0.01
[24–29] vs [12–17]	1.83 [1.24 - 2.72]	< 0.01	1.70 [1.16 - 2.52]	< 0.01
[30–35] vs [12–17]	2.99 [1.95 - 4.63]	< 0.001	2.75 [1.79 - 4.25]	< 0.001
[36–41] vs [12–17]	1.90 [1.17 - 3.11]	0.01	1.93 [1.18 - 3.17]	< 0.01
≥ 42 vs [12–17]	2.98 [1.39 - 6.52]	< 0.01	1.47 [0.69 - 3.14]	>0.05
Gravidity				
Multigravida vs primigravida	0.93 [0.73 - 1.18]	0.56	1.03 [0.81 - 1.31]	0.79
Grand multigravida vs primigravida	0.65 [0.48 - 0.90]	< 0.01	0.90 [0.65 - 1.26]	0.53
Professional status				
Occupation vs unemployed	1.72 [1.27 - 2.37]	< 0.001	1.65 [1.20 - 2.29]	< 0.01

Number of doses of IPT-SP and impact on newborns.

The mean weight of newborns significantly evolves depending on the number of IPT-SP doses received by the mother (Table 3). The mean weight was statistically higher in babies whose mothers had received three (3) doses of IPT-SP ($p < 0.001$). More than 80% of newborns had an excellent APGAR score at birth regardless of the number of IPT-SP doses received by the mother (Table 3). No statistical link was found between the number of IPT-SP doses and the APGAR score of newborns ($p = 0.47$).

Table 3
Distribution of birth weight and APGAR score according to the number of IPT-SP doses.

	Number of doses of IPT-SP					<i>p</i>
	0	1	2	3	> 3	
APGAR score (%)						
Excellent	191 (10.19)	192 (10.24)	399 (21.28)	1076 (57.39)	17 (0.91)	0.47
Good	17 (8.59)	17 (8.59)	37 (18.69)	124 (62.63)	3 (1.52)	-
Low	6 (8.96)	6 (8.96)	18 (26.87)	34 (50.75)	3 (4.48)	-
Very low	4 (11.76)	2 (5.88)	7 (20.59)	21 (61.76)	0 (0)	-
Birth weight in g (SD*)	2871 (536)	2936 (519)	2991 (499)	3049 (485)	3019 (604)	<0.001
*SD: standard deviation						

Plasmodial Infection

Only the 323 parturient women who attended the maternity service from January 1st to April 30, 2020 benefited from a malaria diagnosis from peripheral blood at delivery. The prevalence of plasmodial infection was 3.10% (IC_{95%} = [1.21 - 5]). Mean parasitemia was 817 ± 785 parasites per microliter. *P. falciparum* was responsible for 100% of infections. The average hemoglobin level was 10.3 ± 1.32g/dL. Among the 3.10% (10/323) of infected parturient women, 40% (4/10), 30% (3/10), 20% (2/10) and 10% (1/10) had, respectively, received three, two, one and zero doses of IPT-SP (*p* > 0.05). The prevalence of plasmodial infection was the same for all age groups (*p* = 0.66) (Table 5) and no link was found between gravidity and plasmodial infection (*p* = 0.39). The proportion of parturient women with knowledge on malaria was 99%. Twenty-two percent (22%) of women (IC_{95%} = [17.48 - 26.52]) lived in a house with window screens, 27% (IC_{95%} = [22.16 - 31.84]) used LLINs, 78% (IC_{95%} = [73.48 - 82.52]) used ventilation means (fan and/or air conditioning) and 6.2% (IC_{95%} = [3.57 - 8.83]) used insecticide.

Table 4
Characteristics of plasmodial infection in parturient women.

		Plasmodial infection (%)		<i>p</i>
		Negative	Positive	
Age group (years)	[12 - 17]	14 (93.33)	1 (6.66)	0.66
	[18 - 23]	117 (97.50)	3 (2.50)	
	[24 - 29]	72 (96.00)	3 (4.00)	
	[30 - 35]	73 (96.05)	3 (3,94)	
	[36 - 41]	32 (100)	0 (0)	
	≥42 et plus	5 (100)	0 (0)	
Gravidity	Primigravida	171 (95.53)	8 (4.47)	0.39
	Multigravida	97 (97.97)	2 (2.02)	
	Grand multigravida	45 (100)	0 (0)	
Parity	Primipara	189 (95.93)	8 (4.06)	0.66
	Multipara	101 (98.06)	2 (1.94)	
	Grand multipara	323 (100)	0 (0)	
Knowledge on malaria	Yes	310 (96.88)	10 (3.16)	>0.05
	No	3 (100)	0 (0)	
Window screens	No	244 (96.83)	8 (3.17)	>0.05
	Yes	69 (97.18)	2 (2.82)	
Use of LLINs	No	228 (96.61)	8 (3.39)	>0.05
	Yes	85 (97.70)	2 (2.30)	
Ventilation mean	Yes	245 (97.22)	7 (2.78)	0.46
	No	68 (94.44)	3 (4.17)	
Use of insecticide	No	293 (96.70)	10 (3.30)	>0.05
	Yes	20 (100)	0	
No statistical link was found between the different control measures and plasmodial infection in parturient women (Table 4).				

Plasmodial infection and impact on newborns.

Among parturients infected by *P. falciparum* (Table 6), 60% of newborns had low birth weight (OR= 9.42 [2.55 - 34.75]; $p < 0.01$). Furthermore, 90% of pregnancies were not at term and plasmodial infection was statistically linked to premature births (OR= 69.25 [8.52 – 562.69] $p < 0.001$).

Table 5
Birth weight and term of pregnancy according to malaria diagnosis.

		Blood film of parturient women (%)		<i>p</i>
		Negative	Positive	
Birth weight	Hypotrophy	43 (87.76)	6 (13.95)	<0.01
	Normal	265 (98.51)	4 (01.49)	
	Macrosomia	5 (100)	0 (0)	
Term of pregnancy	Pre-term	36 (80.00)	9 (20.00)	<0.001
	Term	272 (99.63)	1 (00.37)	
	Post-term	5 (100)	0 (0)	

Discussion

Pregnant women are one of the most vulnerable populations to malaria. Indeed, pregnant women are more susceptible to plasmodial infections even though these are often asymptomatic [11]. This susceptibility is in part due to the depression of the immune system during pregnancy which allows women to tolerate the fetus [12]. The effectiveness of IPT-SP has been demonstrated in sub-Saharan Africa [13–15] and in a few localities in Gabon [1, 3]. However, no data regarding the semi-urban and rural regions in southeastern Gabon have been published to date. The objective of this study was, on one hand, to evaluate the level of attendance to prenatal counselling services, and on the other hand, to assess the adherence rate of parturient women to IPT-SP and its impact on newborns, in rural and semi-urban areas in southeastern Gabon.

The mean age of parturient women was the same as the one found in urban regions in Gabon (the capital Libreville and its surroundings) [4]. Moreover, the same trends were observed in several countries of sub-Saharan Africa such as Benin, Burkina-Faso and Senegal [13, 14, 16].

The PNC attendance rate (Figure 1) is significantly higher than the one observed in Libreville and its surroundings (urban area) in 2011 [4] and in other countries in Africa such as Kenya [17] and Benin [18]. These results show a significant improvement in the monitoring of pregnant women in Gabon, probably due to multiple awareness campaigns and free childbirth care since 2017 (for any woman attending a PNC in a health structure recognized by the National Health Insurance Fund in Gabon). In total, 90% of parturient women received at least one dose of IPT-SP and 58.87% received at least three doses, as recommended by the WHO for good adherence. Indeed, since 2003, Gabon has adopted WHO

recommendations [19] for prenatal care and led extensive awareness campaigns on the necessity of using IPT-SP. Our results show a good adherence rate of pregnant women to this new malaria control measure in southeastern Gabon, as is the case in other regions of the country. Indeed, studies led in the capital Libreville and its surrounding areas, Lambaréné and Fougamou have shown that the adherence rate to IPT-SP is good, and has led to a significant decrease in malaria prevalence in pregnant women [1, 3, 4, 6, 20]. Similar results were noted in other African countries such as Kenya or Burkina Faso [21, 22] though a low adherence rate to IPT-SP was reported in an urban area in the south of Benin in 2017 [13]. However, it should be noted that the rate of women receiving at least three doses of IPT-SP during their pregnancy has not changed much since 2007 [3, 4]. These data support the fact that in urban centers, certain categories of women do not have access to socio-economic development. In Gabon, it is therefore urgent to explore new factors which may limit an excellent coverage of IPT-SP.

Moreover, our study showed that parturient women aged less than 18 years old were those with the lowest adherence rate to IPT-SP (Table 2). This could be explained by the fact that these pregnant women were also those who attended PNC the least during their pregnancy ($p < 0.001$), given that prophylaxis with SP is administered to pregnant women during PNC. Indeed, a study performed in Libreville showed that the adherence to IPT-SP was statically linked to the attendance of prenatal counselling services [4]. Our results are also consistent with those of studies in the Democratic Republic of the Congo and in Burkina Faso, which showed that teenagers were less likely to attend PNC during pregnancy [15] and less likely to adhere to IPT-SP. These results could be due to several factors such as financial and geographical constraints, the lack of knowledge on pregnancy risks and the lack of education on the importance of prenatal care. The low attendance to PNC could also be due to socio-cultural aspects such as the shame of being seen by relations, or beliefs according to which a pregnancy can be cursed or unsuccessful if it is revealed too early [23–25]. In contrast to parturient women aged less than 18 years, the 30 – 35 age group had the highest attendance rate to PNC and the best adherence rate to IPT-SP (. This can be explained by the fact that it is in this age group that are found wanted pregnancies, due to marital status or age, and these women carefully seek and follow prenatal care. Our study showed that the professional status of women impacted the attendance rate of PNC as well as the adherence rate to IPT-SP. Indeed, several Gabonese women declared that in the case of IPT-SP stock shortage in prenatal counselling services, pregnant women are often asked to buy their dose of IPT-SP themselves in drugstores, which is often very difficult for this underprivileged population. This was demonstrated in Burkina Faso in a study by Sinare-Ousmane in which 71% of parturient women did not take enough doses of IPT-SP because they were required to pay for treatment [26]. These observations are consistent with results obtained by Amani-Maleya et al in 2019 in the Democratic Republic of the Congo [15]. Furthermore, several studies have shown the importance of economic welfare and educational level for the adherence to IPT-SP [15, 16, 27].

The mean weight of newborns did not differ significantly with the one reported in Libreville between September 2005 and January 2006 (Bouyou-Akotet, et al., 2010) after the implementation of IPT-SP in Gabon. This is not surprising as pregnant women are offered the same care in urban, semi-urban and rural regions in Gabon. The good adherence rate to IPT-SP in this study supports this result. Many studies

have highlighted a decrease in low birth weight with the adoption of IPT-SP [28–30]. In our study, we shown that birth weight was statistically linked with IPT-SP (Table 5). Indeed, we noted a significant birth weight gain for newborns whose mothers took three doses of IPT-SP. These data confirm those previously reported in Libreville and Lambaréné [1, 3] and in several countries of sub-Saharan Africa [31]. Despite the high prevalence of genotypes associated with resistance to SP in some rural areas in Gabon [32], the three-dose IPT-SP policy must be maintained and improved in order to make it accessible to all pregnant women for effective malaria control.

The prevalence of plasmodial infection in pregnant women was lower than those reported by Bouyou et al in 2010 in Libreville and by Mario Jäckle et al in 2011 in Fougamou (in the rural province of la Ngounié in Gabon). The low prevalence observed could be a consequence of the adherence to IPT-SP and treatment recommendations, or self-medication. Besides a good global rate of IPT-SP coverage (90%) and a good adherence rate to IPT-SP (58.87%), we found no link between infection and prevention measures such as the use of LLINs, knowledge on malaria or window screens (Table 4). Furthermore, the prevalence of malaria in peripheral blood in pregnant women found in this study is lower than those reported in 1995 (25%), in 2005 (12%) and in 2011 (6%) [33]. However, parasitic sequestration and submicroscopic infections support an overestimation of this prevalence. Indeed, a study showed that malaria diagnosis by polymerase chain reaction (PCR) leads to a better estimate of malaria prevalence after treatment with SP, since the parasite load decreases in populations after the implementation of new disease control strategies [34]. These infections are a part of plasmodial reservoir. In this study, *P. falciparum* infection was associated with low birth weight and premature births (Table 5). Similar results were found in Libreville [3] and in several other studies [31, 35]. Indeed, the presence of parasite in placenta disrupts exchanges between the mother and the fetus, thus limiting its development. We found no link between plasmodial infection, age and obstetric history (gravidity and parity) of parturient women, unlike previous studies [20, 32, 36–38]. Indeed, it was shown that the decrease in malaria prevalence in pregnant women thanks to prevention means cancels the effect of age and obstetric history on infection [39–41]. The low prevalence of plasmodial infection observed in our study corroborates these observations

Our study has a few limitations. The data gathered on the attendance of PNC and the adherence to IPT-SP were largely based on hospital birth registries (CHRPCK). The data of several parturient women were missing and could not be included in our analyses. In addition, during data collection from January 1st to April 30, 2020, several parturient women were reluctant to answer the questions while others forgot some of their medical information. Finally, the parasitological examination of the umbilical cord and placenta could not be performed especially as *P. falciparum* is often sequestered there, and placental infection is considered as one indicator of malaria in pregnant women [3].

Conclusion

Several years after Gabon implemented WHO monitoring recommendations for pregnant women, our study showed the good attendance of parturient women to prenatal counselling services in southeastern

Gabon. However, the adherence rate to IPT-SP is still insufficient. Awareness campaigns to educate on the importance of antenatal care are essential to improve the monitoring of pregnant women in Gabon.

Abbreviations

WHO

World Health Organization

LLINs

Longlasting insecticidetreated nets

PNC

prenatal consultations

IPT-SP

Intermittent preventive treatment with sulfadoxine-pyrimethamine

CHRPMPK

Centre Hospitalier Régional Paul Moukambi de Koula-Moutou

CIRMF

Centre Interdisciplinaire de Recherches Médicales de Franceville

Declarations

Ethics approval and consent to participate: This study was approved by the National Ethics Committee of Gabon under the number PROT 0020/2020/SG/CNE. The health and administrative authorities of the Ogooué-Lolo province granted permission to consult birth registries. Some informations were collected from a questionnaire filled and signed by the investigator and the parturient woman or the parent/legal guardian for minors, after informed consent.

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Availability of data and materials: Not applicable

Competing interests: The authors have no competing of interests to report

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Authors' contributions: Jean Claude Bitéghé Bi Essone and Imboumy-Limoukou Karl Roméo participated in the interpretation of results, drafting and revision of the manuscript. Ekogha-Ovono Jean Jordan contributed to the acquisition of data in the maternity ward of the CHRPMPK and manuscript writing. Lekana-Douki Jean Bernard, participated in the conception and design of the study and revision of the manuscript. Maghendji-Nzondo Sydney participated in the revision of the manuscript. Lekana-Douki Jean Bernard is the guarantor of this paper. All authors read and approved the final manuscript.

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Figures

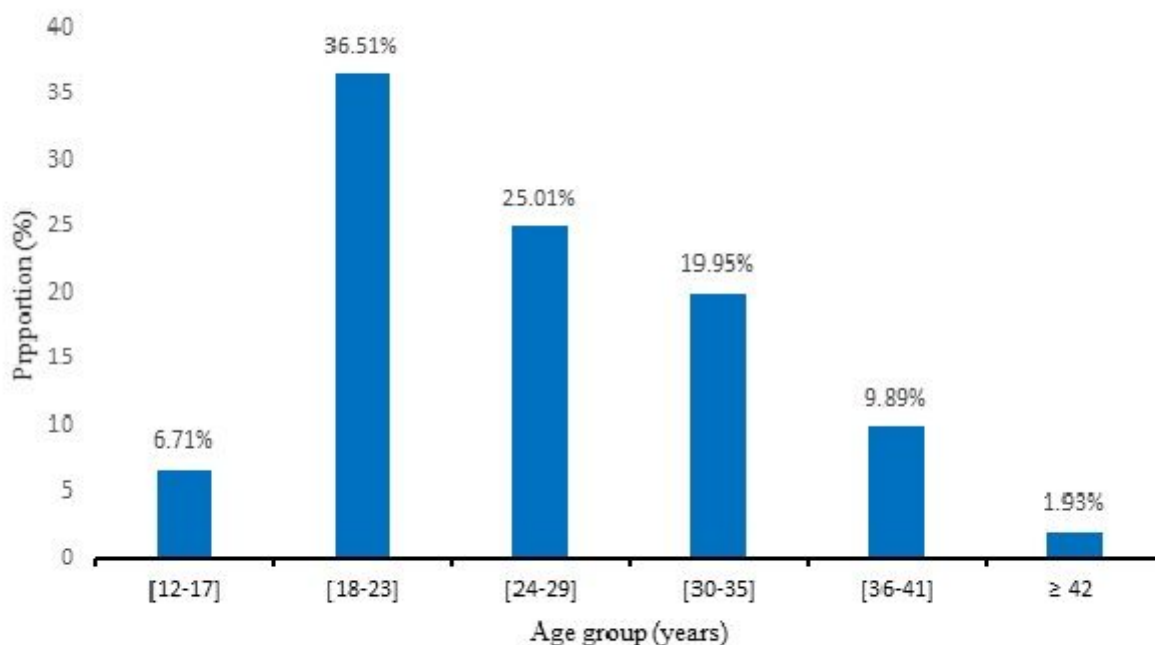


Figure 1

Distribution of parturient women according to age group.

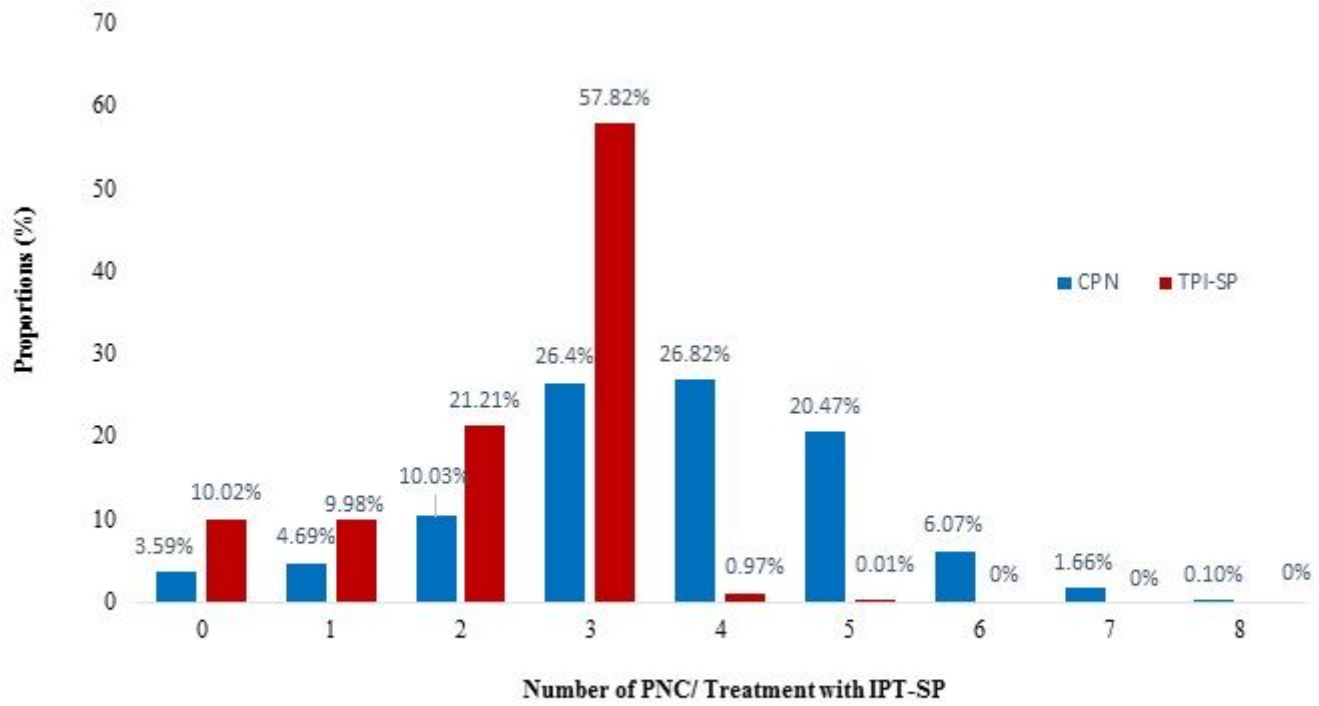


Figure 2

Attendance to PNC and treatment with IPT-SP.