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Coverage and effectiveness of intermittent preventive treatment of malaria with Sulfadoxine-Pyrimethamine during pregnancy in six sentinels' sites of Côte d'Ivoire

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Intermittent preventive treatment of malaria during pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) is recommended to prevent maternal and neonatal adverse outcomes. This study aimed to assess IPTp-SP coverage in mothers delivering in six health facilities and factors associated with placental malaria and low birth weight. A multicenter, cross-sectional survey was conducted in Côte d'Ivoire from March to October 2017. Regression logistics were used to study factors associated with placental malaria, IPTp-SP uptake, and LBW (<2.500 grams). Out of all the enrolled participants (n=1236), 632 (51.1) received three or more doses of SP while 288 (23.3%), 221 (17.9%) and 95 (7.7%) received two respectively, one and none dose of SP. Uptake of ≥ 3 doses varied significantly (p < 0.001) according to study site, number of ANC visits and profession. Regression analysis identified primigravidae, single dose IPTp-SP, or no IPTp-Sp as factors associated with placental malaria. IPTp-SP coverage observed in this study was low compared to WHO recommendation and contrasted with the high antenatal care (ANC) visits. There is a need for further research to understand the barriers and enablers of uptake in each context in order to improve uptake of adequate IPTp-SP regimen.

Key words: Coverage, Effectiveness, Malaria, Pregnancy, IPTp-SP, Côte d'Ivoire.

INTRODUCTION

Malaria in pregnancy is a major public health challenge, affecting about 50 million women per year and presents significant risks for the pregnant woman, the developing fetus and the newborn infant (WHO, 2016). Placental malaria (PM) is associated with intrauterine growth restriction, stillbirth, and delivery of low birth weight (LBW) infants (WHO, 2016). In high-malaria transmission area, women are semi-immune, and most malaria

infections in pregnancy are asymptomatic.

In areas with moderate to high transmission of Plasmodium falciparum, the World Health Organization (WHO) recommends a package of interventions for controlling malaria and its effects during pregnancy, which includes the promotion and use of insecticide-treated nets (ITNs), the administration during pregnancy of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP), and appropriate case management through prompt and effective treatment of malaria in pregnant women (WHO, 2004, 2012). The WHO policy on IPTp-SP considers three and more doses of SP given monthly for intermittent preventive treatment in pregnancy (IPTp-SP 3+) to be optimal, and less than three doses as sub-optimal (Kayentao et al., 2013; WHO, 2018).

Full doses of IPTp-SP are proven to be efficacious and cost-effective strategy delivered through the antenatal care (ANC) (Quakyi et al., 2019). The key goal of the global action plan is to cover 80% of the pregnant women in malaria endemic regions receiving no less than three doses of IPTp-SP in order to reduce the complications that arise from malaria in pregnancy.

The IPTp-SP 3+ policy has been slowly but fully adopted and implemented in sub-Saharan Africa, including Côte d'Ivoire. Today, anti-malaria chemoprophylaxis for pregnant women is therefore a constant in all national malaria control programs in endemic countries. In Côte d'Ivoire a few cross-sectional studies have investigated the effectiveness of IPTp-SP previously (Vanga-Bosson et al., 2011; Toure et al., 2014, 2020). In the context of P. falciparum resistance to SP (van Eijk et al., 2019) in the country regular assessment of IPTp-SP is needed to ensure its effectiveness and efficacy to prevent malaria during pregnancy. Therefore, the aim of this study was to assess the effectiveness of IPTp-SP and its impact on maternal and neonatal birth outcomes in Côte d'Ivoire several years after its adoption. Thus, determining the coverage and effectiveness of this policy is of utmost importance to its sustainability in the country and elsewhere.

MATERIALS AND METHODS

Study sites

This study was a cross sectional study carried out at six National Malaria Control Program (NMCP) sentinel sites for malaria surveillance in Côte d'Ivoire (Abidjan, Abengourou, Man, Yamoussoukro, Korhogo, and San-Pedro). These sites have been NMCP sentinel sites for monitoring of anti-malarial efficacy and IPTp-SP effectiveness since 1996 and 2012, respectively. The criteria for selecting these sites were as followed: sentinels sites for malaria surveillance, implementation of malaria control strategies and Services offered in each site including family planning, antenatal care, delivery, postnatal care, child welfare clinic, and laboratory and pharmacy services. Abidjan is the capital of the country and selected health facilities in this urban site were Anonkoua-Koute and South Abobo facilities.

Study population

The target population was all consenting pregnant women and the study population was all postpartum women aged 15 years and more who had just delivered (< 24 h) and those that delivered at home but visited the health facility of each site for check-up.

Sample size determination

The sample size calculation was based on the estimate of a proportion of PM and LBW after IPTp implementation in previous studies (Vanga-Bosson et al., 2011). With a margin of error of ± 2% using an alpha type-1 error of 5%, at least 1224 pregnant women should be included during the study period, with a minimum of 200 women from each of the six selected sites.

Data collection and quality management

A total of six clinicians and six lab technicians were recruited and trained in data collection methods and management for 2 days, followed by one-day fieldwork. This was done to ensure the data collected were consistent across data collectors, complete and valid. The investigator monitored and supervised the data collectors throughout the data collection exercise.

Enrollment and study procedures

Consenting women who met the study inclusion criteria (singleton pregnancy, IPTp-SP history available, documented HIV negative) were enrolled at the time of delivery.

Socio-demographic characteristics data such as age, educational level, number of children, and occupation were collected directly from participants on Case Report Forms (CRFs).

In addition, data on ANC services were provided including availability or not of SP at the ANC study site, the number of tablets swallowed per dose and whether the drug was administered under supervision were collected directly from participants. For the purpose of accuracy, data on gestational age at first ANC visit, number of ANC visits during their last pregnancy, number of doses of SP taken before delivery and the gestational age at which the first dose of SP was taken, were extracted from the ANC record books of the participants. Other recorded information included, parity, ITNs use, history of malaria illness during pregnancy, and the use of hematinic and anthelmintic drugs.

Sample collection and examination

Blood smears were made using blood collected from mother's peripheral venous, from the maternal side of the delivered placen, and from the umbilical vein cord. side of the placenta with approximately 2 cm × 2 cm in length and width, and 1 cm in depth

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and were used to prepare impression smears after swabbing it on blotting paper.

Thick and thin blood smears were also prepared and stained with Giemsa. Blood slides were examined independently by two experienced laboratory technicians using a light microscope. Discrepant findings were reviewed by a third technician until consensus on positivity was reached. Malaria parasitemia from placental impression smears and placental infection status were performed).

Data analysis

Statistical analysis was performed using Stata® version 10.0 (StataCorp LP, College Station, TX, USA). The data were summarized using descriptive statistics including frequencies, percentages, means, standard deviation, median and ranges. The socio-demographic and ANC characteristics were also grouped into categories. Differences in frequencies were compared by either Chi ‐squared or Fisher's exact tests as appropriate and continuous variables by Student's t‐test when the data were normally distributed. Nonparametric tests were used for non-normally distributed data. In the multivariable analysis, the factors associated with the dependent variable (LBW or PM or IPTp uptake) based on univariate analysis were included.

Outcome variables

The primary outcome was the coverage rate of IPTp-SP (3 does or more), prevalence of PM and LBW. Secondary outcomes were malaria parasites detected during pregnancy and at delivery, adverse birth outcomes (premature birth, fetal anemia, stillbirth, and spontaneous abortion).

Ethical clearance

Ethical clearance was obtained from the National Ethic Committee of Côte d'Ivoire with approval letter reference number 041/IVISHP/CNER-kp. All study participants were informed in their local language about the study objectives and procedures. For each study participant, written informed consent was obtained and the participant was free to withdraw consent at any time of the study without influencing their access to health services. All activities including sample collection, processing, and analysis were carried out as required by the committee.

RESULTS

Sociodemographic characteristics of participants

The socio-demographic characteristics of the 1,236 participants included in this analysis are presented in Table 1. The mean (± SD) age of the delivering women was 26±6.5 years.

Primigravidae and multigravidae constituted 22.9 % and 54.2 % of the study participants respectively. The majority (32.9%) of the participants were 30 or more years-old followed by participants aged between 25 to less than 30 years. The number of ANC visits made ranged from 1 to 8 with a mean of 4.0 ± 1.5 visits. Most of the women had at least 4 ANC visits (55.7%) followed by 3 ANC visits (76.3%). The Overall coverage of ITN was 23.5%.

Prevalence of IPTP-SP uptake and associated factors

A total of 1,236 women were enrolled into the study. 1,236 women, 632 (51.1%) received three (optimal) or more doses of SP, 604 (48.9%) received two or less doses (poor uptake or suboptimal).

The percentage for completing SP doses was different between primigravida and multigravida (22.6% vs 54.9% respectively). At least four ANC visits made by a pregnant woman was associated with higher proportion of taking three or more SP doses than three or less visits (P<0.00001). Uptake of adequate SP dosage varied significantly ($p < 0.0001$) according to the sentinel's site. The highest rate of participants received at least 3 doses of SP was recorded at Korhogo site (67.30%), followed by Man (51%) and Yamoussoukro, and the lowest rate was observed in Abidjan (42.60%) (Table 1). Uptake of ≥ 3 doses varied significantly ($p < 0.001$) according to study site, number of ANC visits and profession (Table 2).

Prevalence of LBW and associated factors

The newborn mean birth weight with one standard deviation was 3,000 (±584) g, and 10.8% (134/1,236) infants had LBW (birth weight less than 2,500 g). The factors associated with LBW in the multivariable analysis were maternal malaria during pregnancy (adjusted odds ratio: 2.02; 95% confidence interval: [1.23–3.23], only one ANC visit (adjusted odds ratio: 2.59; 95% confidence interval: [1.18–5.63] (Table 3).

Prevalence of PM and associated factors

A total of 1,236 placental biopsies were collected and processed for identification of P. falciparum infection. Overall, 7.0% (87) (95% CI 15.2–22.2) women had evidence of PM. The high prevalence was observed at Man site (18.57%) followed by San-Pedro site while none of the participants presented PM at Korhogo site. PM occurred more in primigravidae than in multigravidae (10.24% vs 6.86%). The prevalence of PM in women who had peripheral blood parasitaemia was higher compared to women without peripheral blood parasitemia. The factors associated with PM in the multivariable analysis were maternal malaria at delivery (adjusted odds ratio: 363; 95% confidence interval: [134–1222], Abengourou site (adjusted odds ratio: 0.1; 95% confidence interval: [0.02–0.7] and Man site (adjusted odds ratio: 9.7; 95% confidence interval: [2.69–47.57] (Table 4). The overall prevalence of P. falciparum in maternal peripheral blood at the time of delivery was 8.5% by light microscopy while

Table 1. Sociodemographic characteristics in delivered women according to the number intermittent preventive treatment with sulfadoxine-pyrimethamine doses (n=1236).

Parameter	Total (N=1236)	0 (n=95)	1 (n=221)	2 (n=288)	≥3 (n=632)	p
Age (Year)						
Median±SD	26±6.5	25±6.5	26±6.5	25±6.3	27±6.5	0.007
<20	166 (13.4)	18 (19.0)	33 (14.9)	48 (16.7)	67 (10.6)	0.01
20-24	324 (26.2)	26 (27.4)	49 (22.2)	87 (30.2)	162 (25.6)	0.21
25-29	340 (27.5)	23 (24.2)	68 (30.8)	68 (23.6)	181 (28.6)	0.23
≥30	406 (32.9)	28 (29.4)	71 (32.1)	85 (29.5)	222 (35.1)	0.32
Gravidy						
Median±SD	3±2.0	2±2.21	3±2.2	2.5±1.8	3±1.9	0.04
1	283 (22.9)	26 (27.4)	41 (18.6)	73 (25.3)	143 (22.6)	0.21
2	283 (22.9)	23 (24.2)	48 (21.7)	70 (24.3)	142 (22.5)	0.88
≥3	670 (54.2)	46 (48.4)	132 (59.7)	145 (50.4)	347 (54.9)	0.11
Number of ANC visit						
Median±SD	4±1.5	2±1.8	2±1.3	3±1.2	4±1.1	<0.0001
0	14 (1.1)	14 (14.7)	0 (00)	0 (00)	0 (00)	<0.00001
1	104 (8.4)	20 (21.1)	75 (33.9)	7 (2.4)	2 (0.3)	<0.00001
2	175 (14.2)	26 (27.4)	69 (31.2)	67 (23.3)	13 (2.0)	<0.00001
3	255 (20.6)	8 (8.4)	35 (15.8)	91 (31.6)	121 (19.2)	<0.00001
≥4	688 (55.7)	27 (28.4)	42 (19.0)	123 (42.7)	496 (78.5)	<0.00001
Birth Weight (g)						
Median±SD	3000±584	3000±685	3000±586	2925±572	3000±581	0.03
<2500	134 (10.8)	11 (11.6)	24 (10.9)	35 (12.2)	64 (10.1)	0.82
≥2500	1102 (89.2)	84 (88.4)	197 (89.1)	253 (87.8)	568 (89.9)	-
Locality						
Abidjan	190 (15.4)	25 (62.3)	37 (16.7)	47 (16.3)	81 (12.8)	0.006
Abengourou	202 (16.3)	1 (1.1)	49 (22.2)	56 (19.4)	96 (15.2)	<0.00001
Korhogo	208 (16.8)	0 (00)	37 (16.7)	31 (10.8)	140 (22.2)	<0.00001
Man	210 (17.0)	14 (14.7)	27 (12.2)	62 (21.5)	107 (16.9)	0.04
San-Pedro	200 (16.2)	13 (13.7)	39 (17.7)	53 (18.4)	95 (15.0)	0.48
Yamoussoukro	226 (18.3)	42 (44.2)	32 (14.5)	39 (13.5)	113 (17.9)	<0.00001
Use of LLINs						
No	945 (76.5)	87 (91.6)	165 (74.7)	214 (74.3)	479 (75.8)	0.003
Yes	291 (23.5)	8 (8.4)	56 (25.3)	74 (25.7)	153 (24.2)	-
Occupation						
Student	57 (4.6)	4 (4.2)	12 (5.4)	13 (4.5)	28 (4.4)	0.93
House-wife	699 (56.6)	44 (46.3)	131 (59.3)	165 (57.3)	359 (56.8)	0.18
Public service	63 (5.1)	7 (7.4)	6 (2.7)	20 (6.9)	30 (4.8)	0.12
Others	417 (33.7)	40 (42.1)	72 (32.6)	90 (31.2)	215 (34.0)	0.26
Education						
None	723 (58.5)	50 (52.6)	151 (68.3)	165 (57.3)	357 (56.5)	0.009
Primary	273 (22.1)	25 (26.3)	42 (19.0)	73 (25.4)	133 (21.0)	0.22
Secondary	183 (14.8)	12 (12.6)	23 (10.4)	38 (13.2)	110 (17.4)	0.05
University	57 (4.6)	8 (8.4)	5 (2.3)	12 (4.2)	32 (5.1)	0.02

Table 2. Factors associated with poor IPTp-SP uptake: logistic regression model (n= 1236).

Factor associated	n	IPT carried out, n (%)	Univariate analysis			Multivariate analysis		
			OR	95% CI	P	OR	95% CI	P
Age (year)								
<20	166	148 (89.16)	1	-	-	1	-	-
20-24	324	298 (91.98)	1.39	0.73-2.60	0.30	1.49	0.64-3.38	0.34
25-29	340	317 (93.24)	1.67	0.86-3.19	0.11	1.55	0.61-3.84	0.34
≥30	406	378 (93.10)	1.64	0.86-3.03	0.11	1.52	0.57-3.94	0.38
Gravitidy								
1	283	257 (90.81)	0.72	0.44-1.21	0.21	0.95	0.43-2.15	0.90
2	283	260 (91.87)	0.83	0.50-1.42	0.49	0.77	0.41-1.47	0.43
≥3	670	624 (93.13)	1	-	-	1	-	-
Number of ANC visit								
0	14	00 (00)	0.00	NA	0.97	0.00	NA	0.97
1	104	84 (80.76)	0.17	0.09-0.32	<0.00001	0.15	0.07-0.29	<0.00001
2	175	149 (85.14)	0.23	0.13-0.41	<0.00001	0.18	0.1-0.34	<0.00001
3	255	247 (96.86)	1.26	0.59-3.00	0.57	1.15	0.53-2.78	0.73
4	688	661 (96.07)	1	-	-	1	-	-
Locality								
Abidjan	190	165 (86.84)	1	-	-	-	-	-
Abengourou	202	201 (99.50)	30.4	6.35-546	0.0008	-	-	-
Korhogo	208	208 (100)	NA	NA	NA	-	-	-
Man	210	196 (93.33)	2.12	1.08-4.31	0.03	-	-	-
San-Pedro	200	187 (93.50)	2.17	1.09-4.52	0.02	-	-	-
Yamoussoukro	226	184 (81.41)	0.66	0.38-1.12	0.13	-	-	-
Use of LLINs								
No	945	858 (90.79)	1	-	-	1	-	-
Yes	291	283 (97.25)	3.58	1.82-8.12	0.0006	3.99	1.89-9.85	0.0008
Profession								
Student	57	53 (92.98)	1.65	0.47-6.62	0.44	4.67	1.10-24.61	0.04
House-wife	699	655 (93.70)	1.86	0.73-4.08	0.14	3.97	1.47-9.57	0.03
Public servant	63	56 (88.88)	1	-	-	1	-	-
Others	417	377 (90.40)	1.17	0.46-2.60	0.70	1.73	0.65-4.11	0.23

this prevalence was 13.4% during pregnancy.

DISCUSSION

The purpose of this study was to assess the effectiveness of IPTp-SP in six sentinel sites in Côte d'Ivoire since its adoption by the country in 2005. Usually, ANC serves as a means for providing necessary services during pregnancy, including the provision of insecticide-treated bed nets (ITNs) and IPTp-SP for malaria prevention. Coverage of IPTp with 3 doses of SP found in the current study was 51.1%, similar to those found in WestAfrica(AmankwahandAnto,2019;Amoakoh−Coleman et al., 2020) and elsewhere (Diengou et al., 2020). However, some studies reported high coverage of IPTp-SP, more than 80% in Sierra Leone (Buh et al., 2019), Ghana (Ibrahim et al., 2017), and Tanzania (Protas et al., 2016). Nevertheless, the estimated prevalence of IPTp-SP uptake reported in this study is higher than the prevalence reported in other studies (Orish et al., 2015; Azizi et al., 2018; Azizi, 2020; Yaya et al., 2018; Anchang-Kimbi et al., 2020). The number of times ANC attended during pregnancy was positively associated with IPTp coverage, as it has been found in other studies (Nkoka et al., 2018; Yaya et al., 2018; Amoakoh‑Coleman

Table 3. Factors associated with Low Birth Weight: logistic regression model (n= 1236).

Factors associated	n	Weight < 2500 g, n (%)	Univariate analysis			Multivariate analysis		
			OR	95% CI	P	OR	95% CI	P
Parity								
Primiparous	269	40 (14.86)	1.43	0.93-2.17	0.09	1.35	0.83-2.14	0.20
Secondiparous	350	27 (7.71)	0.68	0.42-1.08	0.11	0.69	0.42-1.10	0.12
Multiparus	617	67 (10.85)	1	-	-	1	-	-
IPTp-SP								
0	95	11 (11.57)	1	-	-	1	-	-
1	221	24 (10.85)	0.93	0.44-2.05	0.85	1.05	0.45-2.67	0.89
2	288	35 (12.15)	1.05	0.52-2.26	0.88	1.67	0.73-4.27	0.24
3	632	64 (10.12)	0.86	0.45-1.78	0.66	1.66	0.72-4.32	0.25
Number of ANC visit								
0	14	3 (21.42)	2.65	0.59-8.77	0.14	3.07	0.55-14.18	0.16
1	104	16 (15.38)	1.77	0.95-3.13	0.05	2.59	1.18-5.63	0.01
2	175	22 (12.57)	1.40	0.82-2.31	0.19	1.79	0.95-3.32	0.06
3	255	29 (11.37)	1.25	0.77-1.97	0.34	1.28	0.78-2.06	0.31
4	688	64 (9.30)	1	-	-	1	-	-
Placental malaria								
Negative	1149	122 (10.61)	1	-	-	1	-	-
Positive	87	12 (13.79)	1.34	0.67-2.45	0.36	2.04	0.79-5.00	0.12
Malaria during pregnancy								
Negative	1090	108 (9.90)	1	-	-	1	-	-
Positive	146	26 (17.80)	1.97	1.21-3.10	0.004	2.02	1.23-3.23	0.003
Peripheral malaria								
Negative	1139	125 (10.97)	1	-	-	1	-	-
Positive	97	9 (9.27)	0.82	0.38-1.60	0.60	0.46	0.16-1.22	0.14
Use of LLINs								
No	945	107 (11.32)	1.24	0.81-1.98	0.32	1.24	0.79-2.00	0.34
Yes	291	27 (9.27)	1	-	-	1	-	-
Profession								
Student	57	10 (17.54)	1.70	0.60-5.01	0.31	1.35	0.46-4.12	0.58
House-wife	699	76 (10.87)	0.97	0.45-2.41	0.95	1.00	0.45-2.55	0.99
Public servant	63	7 (11.11)	1	-	-	1	-	-
Others	417	41 (9.83)	0.87	0.39-2.20	0.75	0.95	0.41-2.46	0.91

et al., 2020). Sensibilization on the dangers of malaria in pregnancy and the beneficial effects of IPTp are factors that contribute to the increase IPTp uptake. This study and the previous one in the country and in other countries in sub-Saharan Africa show that IPTp coverages are not meeting national targets due to various factors (Agarwal et al., 2015; Andrews et al., 2015). Education and timing of antenatal clinic (ANC) visits, economic power to purchase sulfadoxine-pyrimethamine (SP), and stock-outs of SP, ANC user fees, poor counselling are some factors that affected IPTp coverage (Mubyazi et al., 2014; Thiam et al, 2013; Webster et al., 2018). Several reports undertaken in sub-Saharan Africa point to obstacles at all levels of implementation: from healthcare providers, health facility, as well as at higher levels of the health system (Hill et al., 2013; Roman et al., 2019; Olaleye and Walker, 2020).

In this study uptake of adequate SP dosage varied significantly according to the site and the highest rate of participants who received at least 3 doses of SP was

Table 4. Factors associated with placental malaria: logistic regression model (n= 1236).

Factor associated	n	Placental malaria, n (%)	Univariate analysis			Multivariate analysis		
			OR	95% CI	P	OR	95% CI	P
Age (year)								
<20	166	14 (8.4)	1	-	-	1	-	-
20-24	324	29 (8.95)	1.06	0.55-2.13	0.84	1.6	0.52-5.46	0.40
25-29	340	20 (5.88)	0.67	0.33-1.40	0.28	0.8	0.21-3.55	0.84
≥30	406	24 (5.91)	0.68	0.34-1.38	0.27	1.4	0.34-6.28	0.62
Gravitidy								
1	283	29 (10.24)	1.54	0.94-2.50	0.07	1.0	0.33-3.14	0.94
2	283	12 (4.24)	0.60	0.29-1.11	0.12	0.5	0.17-1.40	0.20
≥3	670	46 (6.86)	1	-	-	1	-	-
IPTp-SP								
0	95	9 (9.47)	1	-	-	1	-	-
1	221	12 (5.42)	0.54	0.22-1.38	0.19	0.3	0.06-1.66	0.16
2	288	24 (8.33)	0.86	0.40-2.04	0.73	0.5	0.14-2.33	0.38
3	632	42 (6.64)	0.68	0.33-1.53	0.13	0.6	0.20-2.71	0.55
Malaria during pregnancy								
Negative	1090	75 (6.88)	1	-	-	1	-	-
Positive	146	12 (8.21)	1.21	0.61-2.20	0.55	0.8	0.32-2.15	0.78
Peripheral malaria								
Negative	1139	22 (1.93)	1	-	-	1	-	-
Positive	97	65 (67.01)	103.1	57.75-191.45	<0.0001	363	134-1221	<0.00001
Locality								
Abidjan	190	4 (2.10)	1	-	-	1	-	-
Abengourou	202	9 (4.45)	2.16	0.69-8.11	0.20	0.1	0.02-0.7	0.02
Korhogo	208	0 (00)	0	00-42962.7	0.98	0.0	NA	0.98
Man	210	39 (18.57)	10.6	4.16-359.0	<0.0001	9.7	2.69-47.57	0.001
San-Pedro	200	28 (14.0)	7.5	2.89-25.95	0.0002	1.4	0.30-7.33	0.64
Yamoussoukro	226	7 (3.09)	1.4	0.44-5.74	0.53	0.3	0.04-2.10	0.22
Use of LLINs								
No	945	57 (6.03)	0.55	0.35-0.89	0.01	1.1	0.52-2.40	0.78
Yes	291	30 (10.30)	1	-	-	1	-	-
Profession								
Student	57	3 (5.26)	1.6	0.27-13.22	0.57	1.3	0.09-19.4	0.80
House-wife	699	54 (7.72)	2.5	0.76-15.83	0.20	1.8	0.39-14.5	0.49
Public service	63	2 (3.17)	1	-	-	1	-	-
Others	417	28 (6.71)	2.1	0.63-13.81	0.29	1.5	0.31-12.6	0.64

recorded at Korhogo in the North, followed by Man in the West and Yamoussoukro in the center. Women in rural areas seem to follow this strategy compared to those in urban areas where the lowest coverage rate has been observed (Abidjan). Achieving high coverage of at least three doses of IPTp (IPTp3) will require delivery of high-quality ANC, as recommended in the updated WHO guidance on ANC (WHO, 2016).

The prevalence of PM was 7.0%, relatively lower than that of 9.0% reported in 2014 (Toure et al., 2014), but is

higher than the 4.0% reported among delivering women around the country in 2011 (Vanga-Bosson et al., 2011). In other African countries with stable malaria transmission, the prevalence of infection at delivery ranged from 8.1 to 57.8% (Rantala et al., 2010; Cohee et al., 2014; Chaponda et al., 2015; Mutagonda et al., 2016). The factors associated with PM in this study were maternal malaria at delivery and the locality (Abengourou and Man sites).

In this study, the authors found no significant association between PM and the number of IPTp-SP doses received found in others studies (Fokam et al., 2016; Yoah et al., 2018; Mikomangwa et al., 2020; Mlugu et al., 2020). This may indicate lower effectiveness of SP in clearing or preventing new malaria infection, which is probably due to parasites resistance to SP in the study area (van Eijk et al., 2019).

Although the effect of ≥ 3 doses of IPTp-SP in reducing maternal malaria infection at delivery was non-significant, there was a trend of decreasing parasite densities with increasing number of IPTp doses indicating a benefit of higher IPTp-SP uptake on reducing parasite density (Kayentao et al., 2013; Mpogoro et al., 2014; Arnaldo et al., 2018).

Primigravida were found to have increased susceptibility to PM compared to multigravida. The gravidity-dependent differences in susceptibility to malaria during pregnancy are thought to be related to the development of immunity specific to PM in the second and subsequent pregnancies. More strategies targeting this vulnerable group to improve their health and birth outcomes are needed. The other factors related to PM are locality and malaria infection at delivery.

The authors found a prevalence of LBW of 10.8%, which is higher than the prevalence rate of 9.6% reported in a previous study that demonstrated also a strong association between PM and LBW (Toure et al., 2014).

In this study the factors associated with LBW were maternal malaria during pregnancy and only one ANC visit. This study had the following limitations. First, the study participants were recruited from health facility maternity wings.

Therefore, it would not be representative of the wider population of postpartum women in the sites. Second, the study focused on determinants of IPTp-SP uptake in postpartum women from catchment areas of selected Health facilities in sentinel's district. Results would not be generalized to all districts in Côte d'Ivoire.

Conclusion

The adherence to of a full course of IPTp-SP was low in the study sites compared to the national target of 80%. To effectively addressing the poor coverage and utilization rates, it is absolutely essential to identify the limiting factors in order to developing evidence-based intervention strategies.

CONFLICT OF INTERESTS

The authors have declared any conflicts of interests.

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