

Uptake of Intermittent Preventive Treatment with Sulfadoxine-Pyrimethamine (IPTp-SP) in Pregnancy and Associated Factors in a Malaria Endemic Setting of Sub-Saharan Africa

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Abstract

Introduction: Malaria in pregnancy (MiP) is a public health issue that poses risks to maternal and fetal health. Although the World Health Organization recommends intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) to prevent MiP, its uptake remains low among endemic countries. This study evaluated IPTp-SP uptake and factors associated with its use at Bonassama District Hospital (BDH) in the Littoral Region of Cameroon. **Methods:** A cross-sectional study was conducted at BDH from March to June 2022. Data were collected from antenatal care (ANC) attendees who were over 30 weeks pregnant. Asymptomatic malaria infections were assessed using PfHRP2/pLDH diagnostic testing. Pearson Chi-square and Fisher's Exact tests evaluated associations, while binary logistic regression assessed predictors of optimal IPTp-SP uptake, with statistical significance set at $p < 0.05$. **Results:** Of the 393 participants, 273 (69.5%, 95% CI: 64.7 - 74.0) received optimal IPTp-SP dosing. Predictors of IPTp-SP optimization were level of education, religion, gravida, parity, gestational age at first ANC, number of ANC visits, and maternal knowledge of optimal SP dose. Women who had taken at least

three doses of IPTp-SP had fewer *P. falciparum* infections (aOR = 2.6, 95% CI: 1.65 - 4.14, $p < 0.001$). Primigravida women (aOR = 3.2, 95% CI: 1.69 - 5.98, $p < 0.001$), who started ANC during the first trimester of pregnancy (aOR = 28.5, 95% CI: 12.58 - 64.58, $p < 0.001$), with ≥ 4 ANC visits (aOR = 16.7, 95% CI 7.9 - 35.3, $p < 0.001$) and had good knowledge of optimal SP dosing required during pregnancy (aOR = 3.2, 95% CI: 2.0 - 5.22, $p < 0.001$) were more likely to receive optimal IPTp-SP dosing. IPTp-SP uptake was not associated with the utilization of long-lasting insecticidal nets (LLINs) ($p > 0.05$). **Conclusion:** This study revealed that the optimal uptake of IPTp-SP was below the nationwide 80% coverage target set for 2030. This reinforces the urgency to promote early and frequent ANC visits. Additionally, there is a continuous need for health education highlighting the importance of IPTp-SP uptake and using LLINs as essential strategies to reduce MiP.

Keywords

Pregnancy, Intermittent Preventive Treatment, Sulphadoxine Pyrimethamine, Optimal Uptake, Bonassama District Hospital

1. Introduction

Malaria due to *Plasmodium falciparum* remains a significant infectious disease linked to poverty that is of public health concern despite progress made in recent years. According to the 2023 World Malaria Report, an estimated 249 million malaria cases and 608 deaths were recorded in 85 malaria-endemic countries and territories in 2022, an increase of 5 million cases compared to 2021 [1]. The WHO African Region, with an estimated 233 million cases in 2022, accounted for about 94% of cases globally. Pregnant women, especially primigravida mothers, have an increased susceptibility to malaria infection due to their reduced immunity arising from immunological, hormonal, and physiological changes [2] [3], making them more prone to severe complications, including maternal anemia, low birth weight, and maternal mortality [4] [5]. In 2022, more than 13 million malaria cases were reported among pregnant women globally [6].

Malaria is endemic across all ten regions of Cameroon and is the first major cause of morbidity and mortality among pregnant women. The country is ranked among the 15 highest-burden malaria countries worldwide, contributing over 3% of all global malaria cases and deaths [7]. The prevalence of MiP recorded in 2021 in Cameroon was 39.8% [8]. A pregnant woman suffering from malaria is estimated to be three times more at risk of dying of the disease compared to a non-pregnant woman suffering from the disease [9]. To mitigate these risks of MiP, the World Health Organization (WHO) recommends Intermittent Preventive Treatment with sulfadoxine-pyrimethamine (IPTp-SP) as a cost-effective and proven intervention to prevent malaria transmission. Pregnant women in malaria-endemic zones take IPTp-SP regardless of whether they are symptomatic of

malaria. The IPTp-SP policy recommends that each pregnant woman receive at least three doses of sulfadoxine-pyrimethamine (SP) during pregnancy, starting at 13 weeks of gestation, with doses at least one-month intervals till delivery [10] [11].

In Cameroon, the Ministry of Public Health adopted this protocol in 2004, integrating IPTp-SP with additional preventive measures such as free distribution of long-lasting insecticidal nets (LLINs) and folic acid supplementation as part of antenatal care (ANC) services.[12]. However, coverage has remained below national targets, with recent surveys reporting suboptimal IPTp-SP uptake across several regions. Existing literature in the country revealed that over 54% of pregnant women received at least two doses of intermittent preventative treatment of malaria in pregnancy (IPTp2) in 2018. The proportion of pregnant women who received at least three doses (IPTp3) increased from 26% in 2014 to 32% in 2018 [7]. Recent studies recorded an optimal uptake of 54.9% in 2022 and 65.0% in 2024 within the country's North West [13] and West [14] regions. These observations fall short of the country's target coverage rate of 80% by 2023.

Identifying factors and barriers that limit IPTp-SP uptake in high-burden areas is crucial for strengthening MiP interventions. This study, therefore, aimed to assess the uptake of IPTp-SP during pregnancy and associated factors in Bonassama District Hospital, Littoral Region of Cameroon, a region characterized by high malaria transmission. The findings will provide valuable insights to guide strategies for improving malaria prevention during pregnancy.

2. Material and Methods

2.1. Study Area

This study was conducted in the Bonassama District Hospital (BDH), Littoral Region of Cameroon. The BDH is one of seven health district hospitals located between latitude 4° 4'23.3" North and longitude 9° 41'8.15" East in the city of Douala and circumscribed within the administrative boundaries of Douala IV Sub-Division [4] [15] (Figure 1). The hospital is one of the health facilities in the Bonassama Health District, which is one of the thirty health districts in the Littoral Region of Cameroon. The district has a surface area of about 55 km² with a population of over 350,000 inhabitants and is situated just before the Bonaberi bridge of the Wouri River. The inhabitants of Bonaberi are predominantly Sawa indigenes of the Bantu ethnic group [16]. However, many other tribes and ethnic groups from all over the country and foreigners are also in the locality. Bonaberi is home to many industries, markets, and transport facilities. It is also a cultural hub with a vibrant music scene and a rich history.

The Littoral Region is characterized by a forested equatorial climate and a succession of vegetation, including deep equatorial evergreen forest, mangroves, and humid savannah. The climate comprises four rainy and dry seasons with heavy rainfall (1500 - 5000 mm³/year). Malaria transmission is perennial and holoendemic, with *P. falciparum* the main malarial species [17].

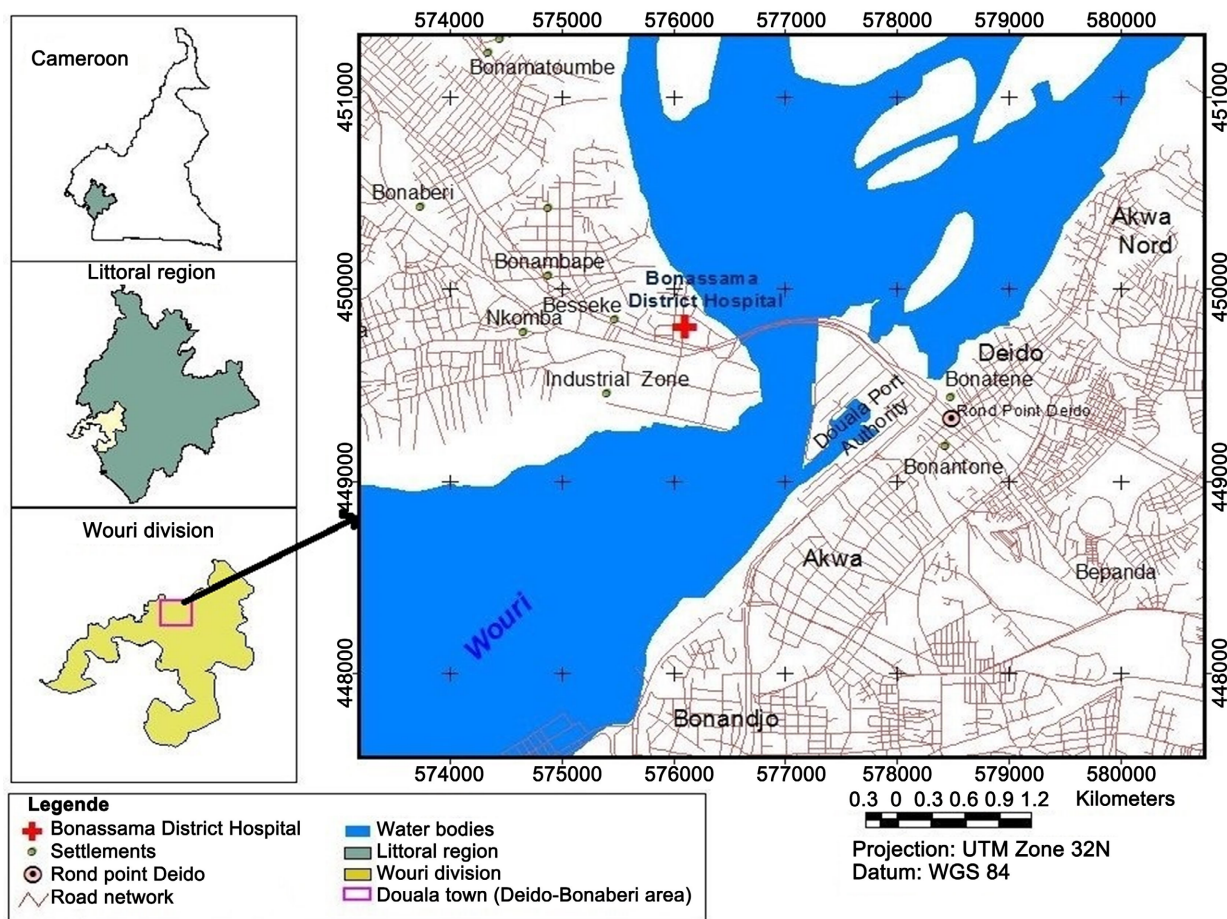


Figure 1. Map showing the location of Bonassama District Hospital.

2.2. Study Design, Population, and Setting

This was a hospital-based cross-sectional quantitative study conducted from March to June 2022 to examine the uptake of IPTp-SP and associated factors in pregnancy. The study population comprised all consenting pregnant women aged 15 - 49 and older than 30 weeks gestational age attending antenatal care at BDH. Pregnant women who were sick were excluded from the study.

2.3. Study Design, Population, and Setting

A minimum sample size of 335 was computed with the Cochran (1977) formula, using an IPTp-SP uptake of 32.0% obtained from the 2018 Demographic and Health Survey summary report data in Cameroon [18]; 95% confidence interval; a margin of error of 5%. The sampling technique was purposive, with participants selected based on specific characteristics relevant to the research. Moreover, participants within this target group were enrolled consecutively as they attended ANC appointments.

2.4. Data and Sample Collection

A semi-structured pretested interviewer-administered questionnaire was designed

and used to document information related to obstetric and socio-demographic, antenatal care history, malaria during pregnancy, intake of IPT, malaria prevention practices, and knowledge of malaria (Suppl 1). Some of these data, including several ANC visits, gestational age at the first ANC visit, and number of SP doses taken, were extracted from the ANC cards of the mothers and ANC registers of the units. Where there was a discrepancy between the verbal information given and that written on the ANC card, what was on the card was used. The data collected for those without antenatal cards was based on interviews and ANC registers. Five research assistants were trained for three days to explain the study objectives, obtain informed consent, and conduct the interviews to ensure uniformity and correctness.

The presence of asymptomatic malaria infection was determined among consenting pregnant women using a Bioline rapid diagnostic test (RDT). About 5 μ l of a capillary blood sample from consenting pregnant women was collected by finger pricking under a standard aseptic procedure. The blood sample was placed in the sample window of the PfHRP2/pLDH malaria rapid diagnostic kit (SD Bioline™, Alere, South Korea) cassette, and three drops of diluent were added. The results were then read after 15 minutes. The presence of two (or three), one, or no distinct lines indicates a positive, negative, or invalid result, respectively.

2.5. Study Variables

The primary outcome measure was the number of IPTp-SP doses received, a dichotomous variable created to have sub-optimal IPTp-SP uptake (≤ 2 doses) and optimal IPTp-SP uptake (≥ 3 doses). A total of 16 independent variables were analyzed in the bivariate analysis. Among them were knowledge of malaria prevention practices, LLINs ownership and utilization, and malaria parasite infection status. Other independent variables were sociodemographic and obstetric characteristics of the respondents, including gravida, parity, gestational age at first ANC, number of ANC visits, age, level of education, religion, distance to the hospital, etc.

2.6. Data Management and Analysis

Data were entered into Microsoft Excel 2018, cross-checked for completeness, and imported into SPSS version 28 for analysis. Descriptive statistics using frequencies, percentages, means, and standard deviation were used to summarize data related to sociodemographic, ANC, and obstetric characteristics and knowledge of malaria and prevention practices. The uptake of IPTp-SP was categorized into < 3 doses versus ≥ 3 doses. Pearson Chi-square and Fischer Exact tests were conducted to establish an association between the uptake of IPTp-SP and each independent categorical variable. To identify predictors of IPTp-SP uptake, variables with a p-value of 0.1 or lower in bivariate analysis were included in the multivariate regression model at a 5% significance level. Adjusted Odds ratios (aOR) with a 95% confidence interval (CI) were reported, and all predictors with $P < 0.05$ were considered to be independently associated with IPTp-SP optimal uptake.

2.7. Ethical Considerations

The study was approved by the Institutional Review Board of the Faculty of Health Sciences, University of Buea, Cameroon (Approval Number: 2022-243061), while administrative authorization was obtained from the Littoral Regional Delegation for Public Health and the Bonassama District Hospital. Written informed consent was obtained from all participants by signing or thumb printing on the informed consent form after the nature and objectives of this study were explained to them. Participation in this study was voluntary. All data gathered was handled under strict confidentiality and stored in a computer with password protection.

3. Results

3.1. Socio-Demographic Characteristics of Study Participants

A total of 393 pregnant women attending ANC at the BDH were enrolled in the study. **Table 1** summarizes the socio-demographic characteristics of the respondents. The participants' mean age (\pm SD) was 28.81 ± 5.60 years, with the majority (55.2%) in the 25 - 34 age group. Most of the women, 165 (42.0%), had a secondary level of education, were of the Christian religion (81.9%), and lived closer to the health facility (72.3%).

Table 1. Socio-demographic characteristics of participants.

Variable	n (%)	95% CI
Age group	<25	107 (27.2)
	25 - 34	217 (55.2)
	>34	69 (17.6)
Mean (SD)	28.81 (5.6)	28.3 - 29.4
Level of education	None	31 (7.9)
	Primary	67 (17.0)
	Secondary	165 (42.0)
	Tertiary	130 (33.1)
Marital status	Single	127 (32.3)
	Married	251 (63.9)
	Divorced/Widowed	15 (3.8)
Religion	Christian	322 (81.9)
	Muslim	71 (18.9)
Distance to hospital	Near	284 (72.3)
	Far	109 (27.7)
Number of pregnancies (Gravida)	Primigravida (1)	89 (22.6)
	Multigravida (>1)	304 (77.4)
Parity (number of children)	Nulliparous (none)	66 (16.8)
	Primiparous (1)	126 (32.1)
	Multiparous (>1)	201 (51.1)

CI: Confidence Interval, SD: Standard Deviation.

Most women (48.3%) reported starting antenatal care during the second trimester, with a total of less than 3 ANC visits (60.1%) (**Table 2**). Three hundred and sixty-two women reportedly owned LLINs (92.1%), with over 222(61.3%) always using them. The majority of the pregnant women had good knowledge of malaria transmission (75.8%), prevention (70.2%), and the required number of SP doses during pregnancy (75.3%) (**Table 3**).

Table 2. ANC and obstetric characteristics (N = 393).

Variable		n (%)	95% CI
Gestational age (weeks)	<34	132 (33.6)	28.9 - 38.5
	≥34	261 (66.4)	61.5 - 71.1
Mean (SD)		35.4 (3.0)	35.1 - 35.7
Gestational age at first ANC	First trimester	147 (37.4)	32.6 - 42.4
	Second trimester	190 (48.3)	43.3 - 53.4
	Third trimester	56 (14.2)	11.0 - 18.1
Number of ANC visits	≤3	236 (60.1)	55.0 - 64.9
	≥4	157 (39.9)	35.1 - 45.0
SP doses received	<2 doses	120 (30.5)	26.0 - 35.4
	≥3 doses	273 (69.5)	64.7 - 74.0

CI: Confidence Interval, SD: Standard Deviation, ANC: Antenatal Care, SP: Sulphadoxine Pyrimethamine.

Table 3. Malaria prevention practices, malaria infection, and knowledge of malaria.

Variable		n (%)	95% CI
Own mosquito nets	Yes	362 (92.1)	88.9 - 94.6
	No	31 (7.9)	5.4 - 11.0
Utilization of mosquito nets (n = 362)	Always use	222 (61.3)	51.4 - 61.4
	Not always use	140 (38.7)	30.9 - 40.6
Malaria infection	Positive	125 (31.8)	27.2 - 36.7
	Negative	268 (68.2)	63.3 - 72.8
Knowledge of malaria transmission	Good knowledge	298 (75.8)	71.3 - 80.0
	Poor knowledge	95 (24.2)	20.0 - 28.7
Knowledge of malaria prevention	Good knowledge	276 (70.2)	65.4 - 74.7
	Poor knowledge	117 (29.8)	25.3 - 34.6
Knowledge of the number of SP doses	Good knowledge	296 (75.3)	70.8 - 79.5
	Poor knowledge	97 (24.7)	20.5 - 29.3

3.2. ANC Attendance and IPTp-SP Uptake During Pregnancy

Of the 393 women, only 157 (39.9%, 95% CI: 35.1 - 45.0) completed the recommended four or more ANC visits (**Table 2**). **Figure 2** shows the IPTp-SP coverage.

Six (1.5%) did not take chemoprophylaxis during their pregnancy, giving IPTp-SP coverage of at least one dose of 98.5% (386/393). Among the women who took IPTp-SP, 273 (69.5%, 95% CI: 64.7 - 74.0) received optimal IPTp-SP dose (≥ 3 doses), while 120 (30.5%, 95% CI: 26.0 - 35.4) took sub-optimal IPTp-SP dose (< 2 doses). The median IPTp-SP dosage received in this study was 3 doses. IPTp-SP optimal uptake was significantly higher ($p < 0.001$) among women with more than four ANC visits (91.1%) than those who recorded three or fewer ANC visits (51.1%).

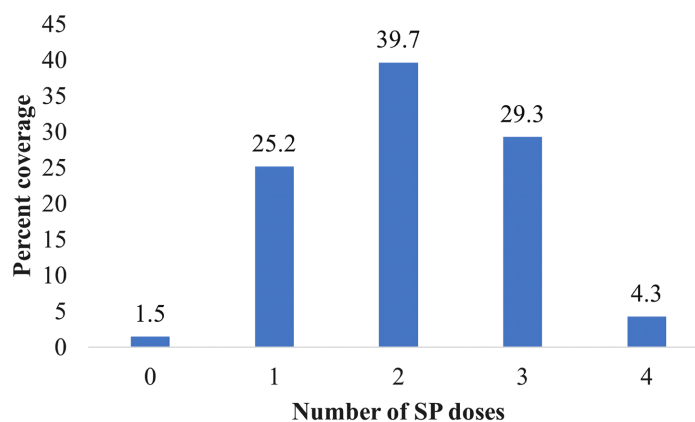


Figure 2. Coverage of intermittent preventive treatment of malaria in pregnancy with sulphadoxine pyrimethamine.

3.3. Asymptomatic Malaria Infection and IPTp-SP Uptake

Of the 393 pregnant women screened for malaria infection, 125 (31.8%, 95% CI: 27.2 - 36.7) were positive while 268 (68.2%, 95% CI: 63.3 - 72.8) were negative (Table 3). It was observed that women who had taken at least three doses of IPTp-SP had fewer *P. falciparum* infections ($p < 0.001$) compared to their counterparts who had taken less than three doses (Figure 3).

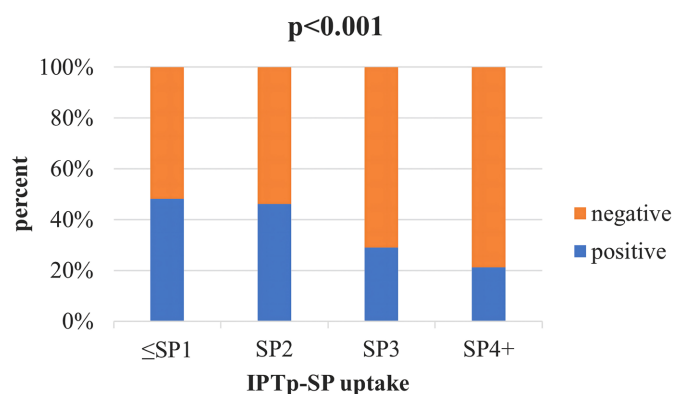


Figure 3. Relationship between IPTp-SP uptake and malaria infection.

3.4. Determinants of IPTp-SP Uptake during Pregnancy

This study compared the characteristics of women who received optimal IPTp-SP

doses to those who received sub-optimal IPTp-SP. Pearson Chi-square and Fischer exact tests revealed that IPTp-SP uptake was significantly associated with level of education ($p < 0.001$), religion ($p = 0.029$), gravida ($p < 0.001$), parity ($p < 0.001$), gestation age at first ANC visit ($p < 0.001$), number of ANC visits ($p < 0.001$), malaria parasite infection ($p < 0.001$) and maternal knowledge of optimal SP dose required during pregnancy ($p < 0.001$) (**Table 4**). Although no significant association was observed between optimal uptake of IPTp-SP and utilization of LLINs ($p = 0.322$), women who always used LLINs (71.6%) tended to have received optimal SP doses compared to those who do not always use LLINs (66.4%)

Table 4. Demographic, obstetric, ANC, and knowledge characteristics associated with IPTp-SP uptake during pregnancy.

Predictors		Optimal uptake n (%)	Unadjusted P-value	OR	CI	Adjusted P-value
Level of education	None	19 (61.3)			Reference	
	Primary	23 (34.3)	<0.001	0.33	0.14 - 0.80	0.014*
	Secondary	134 (81.2)		2.73	1.20 - 6.21	0.017*
	Tertiary	97 (74.6)		1.86	0.82 - 4.23	0.138
Religion	Christian	216 (67.1)			Reference	
	Muslim	57 (80.3)	0.029	2.01	1.07 - 3.75	0.031*
Gravida	Primigravida	76 (85.4)		3.18	1.69 - 5.98	<0.001*
	Multigravida	197 (64.8)	<0.001		Reference	
Parity	Nulliparous	58 (87.9)		3.79	1.71 - 8.39	0.001*
	Primiparous	83 (65.9)	0.002	1.01	0.63 - 1.61	0.972
	Multiparous	132 (65.7)			Reference	
Gestational age (weeks)	<34	79 (59.8)			Reference	
	≥34	194 (74.3)	0.003	1.92	1.25 - 3.03	0.003*
Gestational age at first ANC	First trimester	133 (90.5)		28.50	12.58 - 64.58	<0.001*
	Second trimester	126 (66.3)	<0.001	5.91	3.01 - 11.61	<0.001*
	Third trimester	14 (25.0)			Reference	
Number of ANC visits	≤3	130 (55.1)			Reference	
	≥4	143 (91.1)	<0.001	8.32	4.54 - 15.27	<0.001*
Malaria parasite infection	Positive	69 (55.2)			Reference	
	Negative	204 (76.1)	<0.001	2.62	1.65 - 4.06	<0.001*
Knowledge of the number of SP doses	Good knowledge	225 (76.0)		3.21	2.0 - 5.22	<0.001*
	Poor knowledge	48 (49.5)	<0.001		Reference	

*Statistically significant result at 5% significance level, AOR: Adjusted Odds Ratio, 95% CI: 95% Confidence Interval.

In the multivariate logistic analysis, receipt of optimal IPTp-SP dose was significantly higher among women with a secondary level of education (aOR = 2.7, 95%

CI: 1.20 - 6.21, $p = 0.017$) compared to women with no level of education. Conversely, women of primary level of education were 70% less likely to receive optimal IPTp-SP dose (aOR = 0.3, 95% CI: 0.14 - 0.80, $p = 0.014$). Women who were Muslims were 2 times more likely to receive optimal IPTp-SP dose (aOR = 2.0, 95% CI: 1.07 - 3.75, $p = 0.031$) than their Christian counterparts. It was also observed that primigravida (aOR = 3.2, 95% CI: 1.69 - 5.98, $P < 0.001$) and nulliparous women (aOR = 3.8, 95% CI: 1.71 - 8.39, $p = 0.001$) were 2 times and 3 times more likely to receive optimal IPTp-SP, respectively. Women who started ANC attendance in the first trimester of pregnancy (aOR = 28.5, 95% CI: 12.58 - 64.58, $p < 0.001$) and second trimester (aOR = 5.9, 95% CI: 3.01 - 11.61, $p < 0.001$) were more likely to receive optimal IPTp-SP when compared to those in the third trimester. Those with ≥ 4 ANC visits were about 8 times more likely to receive optimal IPTp-SP dose (aOR = 8.3, 95% CI: 4.54 - 15.27, $p < 0.001$). Women with no malaria parasite infection (aOR = 2.6, 95% CI: 1.65 - 4.14, $p < 0.001$) had an over three-fold increased likelihood to receive optimal doses than those diagnosed with malaria (**Table 4**). Those with a good understanding of optimal SP dose were more likely to receive optimal IPTp-SP dose (aOR = 3.2, 95% CI: 2.0 - 5.22, $p < 0.001$).

4. Discussion

Intermittent preventive treatment of malaria in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) remains a key intervention recommended by the World Health Organization (WHO) to reduce morbidity and mortality associated with malaria during pregnancy. To evaluate the impact of this control measure, there is a need to periodically report the uptake of IPTp-SP in malaria-endemic areas. This study sought to assess the uptake of intermittent preventive treatment with Sulphadoxine pyrimethamine during pregnancy (IPTp-SP) and associated factors in Bonassama District Hospital. This study's most represented age group was 25 - 34 years. Studies in Cameroon [14] and Kenya [19] reported similar results, with women aged 24 - 34 being the most represented.

Our results showed that 98.5% of the pregnant women had taken at least one dose of IPTp-SP. Similar results were observed in studies conducted in various parts of Cameroon: Bamenda (98.35%) by Diengou *et al.* [20], Southwest (92.9%) by Anchang-Kimbi *et al.* [21], Littoral (94.9%) by Moukoko *et al.* [22]. The World Health Organisation (WHO) recommends optimal uptake of three or more doses of IPTp-SP during pregnancy and coverage of at least 80% [11] [20]. However, our study recorded an optimal uptake of IPTp-SP of 69.5%, similar to the optimal uptake of IPTp-SP of 64.99% in a recent study conducted in the western part of the country by Kamga *et al.* [14]. Contrary to our results, lower optimal uptake was obtained in other parts of Cameroon: South West (47.0%) [21] and North West (54.9%) [13] regions. Moreover, 36.8% was obtained among women in Northern Nigeria in 2012, and 55.1% of women in private health facilities in Ghana in 2019 [23] [24]. Despite this variation, it's interesting to note that, though optimal uptake is lower than the WHO recommended target, endemic countries

progressively adhere to it from 2012 to 2024. The differences in optimal uptakes might be due to challenges in implementation, level of compliance, and intensity of malaria transmission. The combination of sulfadoxine-pyrimethamine is recommended for malaria prophylaxis because it blocks the parasite's utilization of folic acid, killing the parasite [25].

Our study also revealed a significant association between the uptake of IPTp-SP and asymptomatic malaria infection. Women who had taken the optimal doses recommended for IPTp-SP (≥ 3) had fewer *P. falciparum* infections than their counterparts who had taken less than three doses. Interestingly, other studies in the Southwest of Cameroon in 2020 and 2022 and Littoral, Cameroon in 2023 reported similar results [21] [22] [26]. This confirms that optimal doses of IPTp-SP protect against malaria [11] [27]. Although our study did not reveal any significance between good knowledge of transmission and prevention, most of those with good knowledge received optimal doses of SP. These women might have been counseled against the dangers of malaria infection during pregnancy in health talks given during ANC. A study carried out in six districts of Tanzania reported similar results [28]. Moreover, studies conducted in Benin confirmed that women with comprehensive knowledge of malaria were almost 5 times more likely to receive optimal doses of IPTp-SP [29].

Our results revealed some determinants of uptake of IPTp-SP, including level of education, religion, parity, gestational age at first ANC, number of ANC, malaria infection, and knowledge of the number of SP doses. Educational level was a great determinant of uptake of optimal doses of IPTp-SP [24] [28] [30]-[32]. Educated women are more likely to understand the devastating consequences of malaria in pregnancy, as revealed by our study, where women with a secondary level of education were 3 times more likely to receive the optimal dose of IPTp-SP compared to those with no level of education. This aligns with studies conducted in Nigeria by Kalu *et al.* [33], who reported that apart from the household index and media exposure, a spouse's education level positively influenced the uptake of optimal doses of IPTp-SP. This is contrary to a study conducted in Benin [29] and Cameroon [34], where the level of education was not significantly associated with the uptake of IPTp-SP. This can be explained by the fact that there have been advances in knowledge due to increased awareness in recent years. It was also observed that primigravida women experiencing pregnancy for the first time with excitement were 3 times more likely to receive IPTp-SP compared to multigravida women who were acquainted with the situation. Nulliparous women were 4 times more likely to receive optimal IPTp-SP. This is possible because since it is their first experience, they fear losing their first child to malaria compared to those who have had multiple births. The period when women started ANC was significantly correlated to IPTp-SP uptake. Women who started ANC attendance in the first trimester of pregnancy were 29 times more likely to receive IPTp-SP than those who started during the second and third trimesters. This is comparable to studies conducted in Burundi, Western Kenya, and Ghana [19] [23] [28] [31]. The number of ANC visits was also positively correlated with the uptake of IPTp-SP in our

study. Those with ≥ 4 ANC visits were about 8 times more likely to receive the optimal IPTp-SP dose. This corroborates with other studies that identified ANC visits as a determinant of uptake of IPTp-SP [19]-[22] [27] [30]. This is possible because, during such visits, women are constantly reminded of the consequences of malaria in pregnancy, both to the mother and the child, which is reflected in the optimal uptake of IPTp-SP.

Although our results did not show any significant association between utilization of LLINs and optimal uptake of IPTp-SP, women who always used LLINs (71.6%) tended to have received optimal SP doses compared to those who do not always use LLINs (66.4%). However, this differs from studies that reported LLIN utilization as a significant determinant of SP uptake [24]. When uptake was associated with malaria infection, our results revealed that women who received the optimal IPTp-SP doses were almost 3 times less likely to have malaria parasite infection than those who did not. This is similar to studies in Southwest Cameroon, where malaria prevalence was reduced in women with optimal uptake of IPTp-SP [21]. This shows that optimal uptake of IPTp-SP can prevent malaria, as confirmed by the fact that 76.1% of the participants with optimal uptake in our study were negative for malaria. Furthermore, other studies reported that there was more likelihood of malaria in Southeastern Nigerian women who failed to take optimal doses of IPTp-SP [35]. An understanding of the reasons why a drug is taken will always encourage the uptake of the drug. This study found that those with a good understanding of optimal IPTp-SP dose were 3 times more likely to receive optimal IPTp-SP dose. This was also reported by Badirou and colleagues [29], who reported that women with adequate knowledge of IPTp-SP doses were 3.3 times more likely to receive optimal IPTp-SP doses. Other studies also supported that maternal knowledge of optimal doses was significantly associated with the uptake of IPTp-SP [19].

5. Conclusion

In this study, the optimal uptake of IPTp-SP, as recommended by WHO, was 69.5%, though below the 80% coverage expected by 2030 in the country. Optimal uptake of IPTp-SP was found to be significantly associated with ANC attendance and malaria infection. Determinants of uptake of IPTp-SP included level of education, religion, parity, gestational age at first ANC, number of ANC, malaria infection, and knowledge of the number of SP doses. Healthcare providers should emphasize early ANC engagement through education and health talks, encouraging women to begin ANC within the first trimester to access timely IPTp-SP. Additionally, training healthcare staff in effective counseling techniques will help bridge literacy and knowledge gaps, enabling them to clearly and consistently convey the importance of IPTp-SP uptake.

6. Study Limitations

This study employed a cross-sectional study design whose weakness is the impossi-

bility of inferring causation. Only women in the third trimester of pregnancy (>30 weeks of gestation) were included in the study who could possibly attend another ANC or take another IPTp-SP dose. A study that included women attending post-natal care could give a better picture of the uptake of IPTp-SP doses. Moreover, some answers to questions, such as sleeping under LLINs, were self-reported by the participants and not observed by the researchers. However, self-reporting was minimized by verification of some responses using ANC clinic attendance booklets. In addition, with all survey data, the findings are limited by recall and social desirability biases. Finally, this study cannot be generalized to the whole population in Cameroon as the sample was selected from only one health facility. Expanding the study to multiple healthcare centers across different regions would also enhance generalizability, capturing a broader range of socio-demographic and health-seeking behaviors, which could offer more representative findings and better inform public health strategies.

Author Contributions

MUA, IUA, and TOA conceived and designed the experiments. CKN, CMN, and SF conducted the study. MUA, TOA, KBW, and IUA performed the analysis. MUA, IUA, JN, and MA drafted the manuscript. All authors contributed to the revision of the manuscript before submission.

Conflicts of Interest

The authors declare no competing interests.

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Abbreviations

ANC	Antenatal care
aOR	Adjusted odd ratio
BDH	Bonassama District Hospital
CI	Confidence Interval
IPTp-SP	Intermittent preventive treatment in pregnancy with Sulphadoxine pyrimethamine
LLIN	long-lasting insecticide-treated nets
MiP	Malaria in pregnancy
NMCP	National Malaria Control Programme
RDT	Rapid diagnostic test
SD	Standard deviation
SP	Sulphadoxine pyrimethamine
SSA	Sub-Saharan African
WHO	World Health Organization