

The Impact of Intermittent Preventive Treatment with Sulphadoxine Pyrimethamine on Pregnant Women and Newborns at Bon Samaritain

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Abstract

Background

In 2014, the Chadian government initiated a preventative campaign to combat malaria. As part of this program, pregnant women were provided with free intermittent preventive treatment with sulphadoxine-pyrimethamine (IPTp-SP). The primary objective of this study was to evaluate the impact of IPTp-SP on maternal and neonatal health at a hospital in N'Djamena, Chad.

Methods

A cross-sectional study was conducted over a period of 14 months, involving 149 pregnant women who were monitored until delivery for various outcomes such as malaria attacks, anemia, placental malaria, low birth weight, and prematurity in newborns. The data was collected using a pretested questionnaire, and analysis was carried out using SPSS and Rstudio. Odds ratio was calculated to evaluate the results.

Results

The study participants had a mean age of 25.8 ± 6.2 years, with 72.5% of them below the age of 20 years. About half of the participants were housewives with a high school education. It was observed that more than half of the pregnant women (84, 56.3%) did not use insecticide-treated mosquito nets. Out of the 149 study participants, 64 (42.95%) received three or more doses of IPTp-SP, while 31 (20.8%) did not receive any dose of IPTp-SP. Among the total participants, only 30% (45) reported being malaria-positive, while 28.9% (43) were diagnosed with placental malaria. Out of the 43 cases of placental malaria, 21 (48.83%) had not received SP treatment. It was observed that most low-birth weight babies weighing less than 2500g (40, 81.64%) were born to pregnant mothers who had received only one or no dose of SP. Among the 31 pregnant women who did not receive IPTp-SP, 21 (67.7%) reported at least one attack of malaria during their pregnancy. In comparison, only 22 out of 118 (18.7%) women who received at least one dose of sulphadoxine-pyrimethamine reported a malaria attack during their pregnancy ($p = 0.001$). Out of the 31 pregnant women who did not receive IPTp-SP, 26 women (83.9%) reported anemia with Hb levels below 10.5g/dl, while 17 (65.4%) reported severe anemia with Hb levels below 8g/dl.

Conclusion

The administration of three or more doses of sulphadoxine-pyrimethamine was found to significantly decrease the maternal rate of malaria attack, placental infection, maternal anemia, and low birth weight babies.

Keywords: Malaria, Intermittent Preventive Treatment, Sulfadoxine-Pyriméthamine, Pregnancy, Newborn, Developing Nation, Chad

Abbreviations

ANC : antenatal consultation

EDS-MICS: Demographic and Health Survey and Multiple Indicators in Chad

IPTp-SP: intermittent preventive treatment with sulfamethoxazole-pyrimethamine

ITN : Insecticide-treated net

LBW : Low birth weight

LLIN : Long-lasting insecticide-treated net

PNLP: Programme National de lutte contre le paludisme

SP: Sulfamethoxazole – pyrimethamine

WHO : world health organization

1. Background

According to the World Health Organization (WHO), in 2019, an estimated 35% of pregnant women in approximately 33 countries in the African Region with moderate to high transmission of malaria were exposed to malaria infection. Additionally, it was estimated that 822,000 children had low birth weight (LBW) [1]. According to WHO estimates, the Central African subregion had the highest exposure to malaria during pregnancy (40%), followed closely by West Africa (39%) and East-Southern Africa (24%) [1]. In sub-Saharan Africa, *Plasmodium falciparum* is reported to be the primary infecting parasite, responsible for 99% of all

cases of malaria during pregnancy [2]. During pregnancy, malaria is characterized by the sequestration of infected erythrocytes in placental intervillous spaces, which bind to Chondroitin sulphate-A, leading to placental malaria [3,4]. Malaria infection during pregnancy poses significant risks to both the pregnant woman and the fetus. Malaria infection during pregnancy can lead to placental sequestration of the parasite, which, in turn, can cause maternal anemia with subsequent consequences [5,6]. Additionally, malaria infection puts the mother at an increased risk of death before and after childbirth and is a significant contributor to stillbirth and preterm birth. Placental malaria infection can lead to poor fetal growth and low birth weight (LBW) and is a significant risk factor for perinatal, neonatal, and infant mortality [7-10]. Recent studies have shown that placental malaria is associated with maternal anemia and LBW newborns [11]. At the same time, using insecticide-treated nets (ITN) and IPTp-SP has reduced the odds of malaria during pregnancy [12].

To prevent the consequences of malaria infections, WHO recommends using IPTp with SP as part of antenatal care (ANC) in areas of moderate to high transmission, combined with vector control, prompt diagnosis, and effective treatment of malaria [13]. According to the Demographic and Health Survey and Multiple Indicators in Chad (EDS-MICS), malaria is the primary cause of

morbidity and mortality in Chad and outpatient consultation [14].

In 2010, malaria was reported to be the leading indirect cause of maternal mortality (84.6%) and the second leading cause of infant mortality (25.57%) [15]. In May 2005, during the National Malaria Management Policy Change Workshop in Chad, it was decided that Chloroquine chemoprophylaxis should be replaced with IPTp-SP [16]. Per the recommendations of WHO, sulphadoxine-pyrimethamine (SP) is administered with a minimum of three doses, starting during the second trimester, and spaced at least 1 month apart [17]. A meta-analysis study has shown that administering three or more doses of SP is more effective than the two doses previously recommended by WHO guidelines [16]. After implementing the new WHO strategy in February 2014, a study was planned to evaluate the outcome of using IPTp-SP and ITN through compliance to ANC of pregnant women at Bon Samaritain Hospital in Chad. The study aimed to identify various factors that may influence the prescription and adherence to IPTp-SP and assess the results of this prevention.

2. Methods

2.1 The Aim, Study Design, Setting, and Participants

This cross-sectional study was conducted over a period of 14 months, from June 01, 2014, to July 31, 2015. The study included all pregnant women enrolled in the antenatal consultation performed by the two primary healthcare facilities administratively linked to the Department of Obstetrics & Gynaecology of Bon Samaritain Hospital in N'Djamena, the capital and largest city in Chad. Malaria is endemic to the city, particularly during the rainy season when there is a reported rise in mosquito habitats [18].

The hospital's Obstetrics and gynecology department consisted of seven wards with 27 beds and performed an average of 700 deliveries yearly. During the study period, 861 pregnant women were admitted to the unit for delivery, out of which 149 fulfilled the inclusion criteria and consented to participate in the study. The preliminary phase of the study involved providing information on intermittent preventive treatment to pregnant women.

3. Characteristics of Participants

3.1 Inclusion Criteria

The study recruited women with singleton pregnancies in their first or second trimester. These pregnant women agreed to participate in the study and planned to give birth at the Obstetrics & Gynaecology Unit of the university medical hospital, Bon Samaritain, regardless of the terms of IPTp-SP administration.

3.2 Exclusion Criteria

Pregnant women with a history of allergy to sulfonamides and those with high-risk pregnancies or complications such as hypertension, diabetes mellitus, antepartum hemorrhage or postpartum bleeding, eclampsia, and other complications were excluded from the study.

4. Study Variables

4.1 Independent Variables

The independent variables in the study included the number of IPTp-SP doses administered, sociodemographic characteristics such as age, education level, and occupation of the patient, as well as clinical parameters like parity, use of insecticide-treated mosquito nets, the number of antenatal consultations, and reasons for not taking IPTp-SP in the previous pregnancy.

4.2 Outcome Details

The outcome variables in the study included malaria attacks-related positivity on the blood smear, hemoglobin level, anemia, and placental malaria for pregnant women. The variables considered for analysis were low birth weight and prematurity for newborns.

4.3 Data Collection Techniques and Tools

Data for the study was collected through a pretested questionnaire consisting of four main parts: (i) sociodemographic and obstetric information, (ii) antimalarial prophylaxis, (iii) blood test results, and (iv) newborn information. During antenatal consultation, data regarding ITN usage, including the use of ITNs in previous pregnancies, reasons for noncompliance, and frequency of ITN use, specifically SP, were also collected. The pregnant women were informed about the study protocol and the blood collection procedure for diagnosing placental malaria by well-trained healthcare workers. Birth weight was measured by the attending midwife for all births within 30 minutes of delivery, using an electronic scale that was accurate to ± 10 grams and calibrated weekly. Newborns were classified as either normal birth weight (≥ 2.5 kg) or LBW (< 2.5 kg) in accordance with WHO guidelines [19]. The study investigators, who were healthcare workers, collected data from the study population through face-to-face interviews. The information obtained from the patients was cross-checked with hospital records. A pretested questionnaire was conducted a month before the survey on a sample of 30 pregnant women, which allowed us to make necessary amendments to our survey sheet.

4.4 Laboratory Testing and Materials

Blood samples were collected at delivery from a finger prick for malaria microscopy and to measure hemoglobin (Hb) levels. In contrast, placental blood samples were collected for malaria microscopy. Placenta blood smears were obtained from the intervillous space of the maternal side of the placenta. The blood smear for malaria was prepared using 10% Giemsa stain with pH 7.2 and examined under 100X objective lens oil immersion of a light microscope. Microscopic examination of thick films was conducted to detect the presence of parasites under high power magnification. This was done using the guidelines provided by WHO [20]. Maternal hemoglobin concentrations were estimated with a portable HemoCue device (Angelholm, Sweden). Anemia was defined as Hb levels below 10.5 g/dL, while severe anemia was defined as Hb levels below 8 g/dL [21].

4.5 Ethical Consideration

The university medical hospital team, the Medical Director, and the administration of the Bon Samaritain hospital have authorized and approved the author to conduct this study. The author explained the study protocol and details and obtained approval. Participants were given a thorough explanation of the study's purpose, details, and blood-taking procedures for malaria and placental malaria. Face-to-face interviews were conducted to answer questionnaires, and participants were given an explanation and asked for verbal consent for study participation, as well as intravenous and placenta blood taking. The research team maintained the principle of anonymity throughout the investigation, and verbal consent was obtained from all participants regarding the interview and blood collection.

5. Data Analysis

The collected data was analyzed using SPSS V.20.0 (SPSS Inc., Chicago, IL, USA) and RStudio IDE (integrated development environment) version 3.6.3 of 2020-02-29. The occurrence of morbid events in the two groups receiving IPTp-SP was compared using the odds ratio. Differences in proportions were analyzed using the chi-square χ^2 -test, with a significance level set at $P < 0.05$. Parity was categorized as primipara, pauci-parous (women

with 2-5 births), and grand-multiparous (women with more than 5 births). For research purposes, women were diagnosed as malaria-positive if parasites were detected in their peripheral blood by light microscopy with Giemsa staining. The diagnosis of placental malaria was considered positive if the placental samples collected from the placenta were found to be positive. The data regarding IPTp-SP dosage intake was categorized into three groups: no IPT-SP doses, one or two (<3) IPTp-SP doses, and three or more (≥ 3) IPTp-SP doses.

6. Results

6.1 Sociodemographic Characteristics of Study Participants

In the study, out of 149 pregnant women, most were under 20 years of age, accounting for 72.5% of the participants. The average age of the participants was 25.8 ± 6.2 years (Table 1). Additionally, around one-fourth of the participants, that is 24.2% (36 women), belonged to the age group of 20-35 years. As per Table 1, almost half of the respondents had completed their secondary school education (47.0%). In terms of occupation, half of the study participants, that is 75 women (50.3%) reported being housewives, while 24.8% ($n = 37$) of the participants were traders. For more detailed information about the participants' sociodemographic characteristics, please refer to Table 1.

Sociodemographic characteristics

Variable / Age (year)	Frequency (n)	Percent (%)	Variable / Occupation	Frequency (n)	Percent (%)	Variable / Education	Frequency (n)	Percent (%)
<20	108	72.5	Housewives	75	50.3	illiterate	17	11.4
20 - 35	36	24.2	Trader/Shopkeepers	37	24.8	Elementary	42	28.2
>35	5	3.3	Salaried Workers	29	19.4	Secondary	70	47
Total	149	100	Liberal/Odd jobs	8	5.5	University	20	13.4
			Total	149	100	Total	149	100

Reproductive and obstetric history												
Variable / Parity	Frequency (n)	Percentage (%)	Variable / ANC Visit	Frequency (n)	Percentage (%)	Variable / LLINs	Frequency (n)	Percentage (%)	Variable/Dose of SP	Frequency (n)	Percentage (%)	
Primiparous	44	29.5	0	31	20.81	Yes	60	40.3	0	31	20.81	
Pauci-Parous (2-4)	54	36.3	1	6	4.03	No	84	56.3	1-2	54	36.24	
Grand Multiparous	51	34.2	2	31	20.81	Sometimes	5	3.4	≥3	64	42.95	
Total	149	100	3	67	44.96	Total	149	100	Total	149	100	
			4	13	8.72							
			5	1	0.67							

			67	
	Total	149	10	0

Table 1: Sociodemographic characteristic and obstetric history

ANC- Antenatal care

SP-Sulphadoxine pyrimethamine

LLINs-Long-Lasting Insecticide-treated Nets

7. Reproductive and Obstetric History of Participants

In the study, parity was divided into three categories; primiparous (women who are pregnant for the first time or have given birth to only one child), pauci-parous (women with 2-5 births/children), and grand-multiparous (women with more than 5 births/children). As per Table 1, most pregnant women in the study were pauci-parous, accounting for 36.3% (54 women), followed by grand-multiparous, accounting for 34.2% (51 women). Moreover, most of the women attended three or more antenatal consultations, accounting for 53.75% (81 women) (Table 1). However, as per Table 1, 31 (20.81%) pregnant women reported not attending any ANC visit at all, while the remaining 118 (79.19%) reported at least one prenatal visit during their pregnancy.

8. Compliance with IPT-SP Regimens

As per Figure 1, a significant proportion of pregnant women reported being non-compliant with IPTp-SP for their previous pregnancies. Specifically, 115 (77.2%) out of 149 pregnant women reported non-compliance with the treatment. The most common reasons for non-compliance with the treatment, as quoted by the participants (Figure 1), included "first pregnancy" (43, 28.9%), "no time" (21.14%), "no prescription" (20, 13.4%), "lack of disease" (13, 8.7%), "form of a tablet" (6, 5.2%), "marital conflict" (5, 4.3%), and "no money" (4, 2.3%). The remaining reasons, as per Figure 1, were represented by "oversight," "trip," and "no response," with each being reported by 1 participant (0.9%).

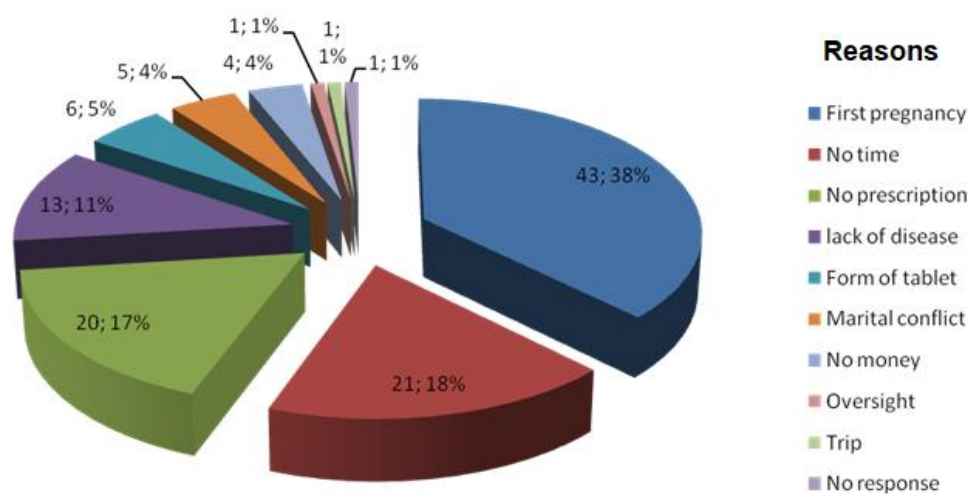


Figure 1: Reason for non-compliance with Sulfamethoxazole pyrimethamine

9. Malaria Prevention Regimens

As per Table 1, more than half of the pregnant women in the study, that is, 84 out of 149 (56.3%), reported never having used insecticide-treated mosquito nets. Furthermore, out of the 149 pregnant women, only 64 (42.95%) reported using all three doses of IPTp-SP (Table 1).

10. Prevalence of Malaria in Pregnancy (Table 2)

As per the study findings, out of the total 149 participants, 45 (30.2%) women were diagnosed with malaria, while 43 (28.86%) were diagnosed with placental malaria.

Dose of SP	Malaria	Placental	Anaemia (Hb<10.5g/dl)	LBW
		Malaria		
0	21 (46.67%)	21 (48.83%)	26 (28.89%)	19 (38.78%)
1	18 (40%)	18 (41.86%)	24 (26.67%)	21 (42.86%)
2	3 (6.67%)	3 (6.98%)	20 (22.22%)	5 (10.2%)
3	3 (6.67%)	1 (2.33%)	20 (22.22%)	3 (6.12%)
4	0	0	0	1 (2.04%)
Total	45 (30.2%)	43 (28.86%)	90 (60.4%)	49 (32.88%)
OR	OR = 0.39, 95% CI 0.16 - 0.94; P < 0.001	OR = 9.16, 95% CI 3.79 - 22.18; P < 0.001	OR = 6.18, 95% CI 2.24 - 17.01; P < 0.001	OR = 52.89, 95% CI 14.74 - 189.81; P < 0.001

Table 2: Protective effect of SP on Malaria, Placental malaria, and Anemia

11. Malaria Crisis in Pregnant Women

According to Figure 2, 67.7% (21 out of 31) of pregnant women who did not use any dose of SP reported at least one attack of malaria, compared to 18.7% (22 out of 118) of those who had used at least one dose of SP (p = 0.001).

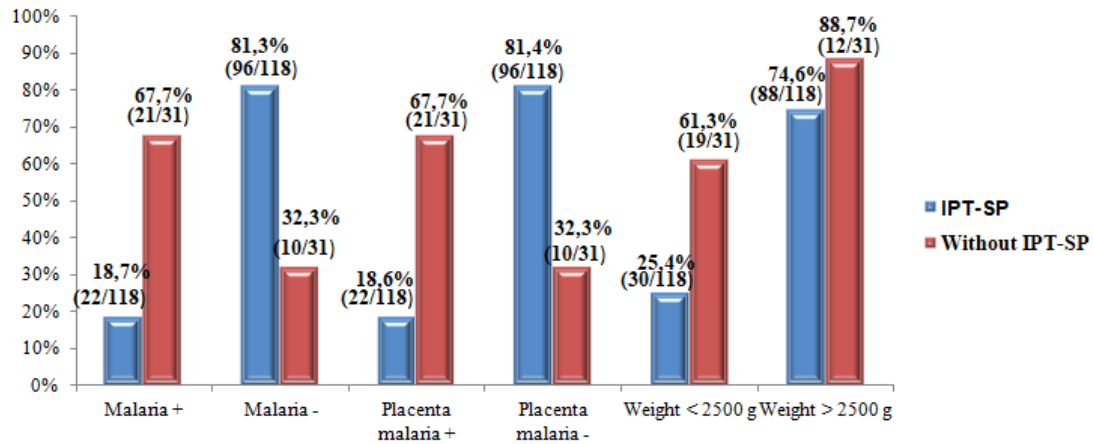


Figure 2: Distribution according to compliance to IPT-SP and complications

12. Anemia

As per Figure 3, 83.9% of pregnant women who did not receive IPT-SP were found to be anemic, compared to 54.2% of those who received at least one dose of SP. Among the anemic pregnant women, 65.4% and 14% (Figure 3) were diagnosed with severe anemia, respectively.

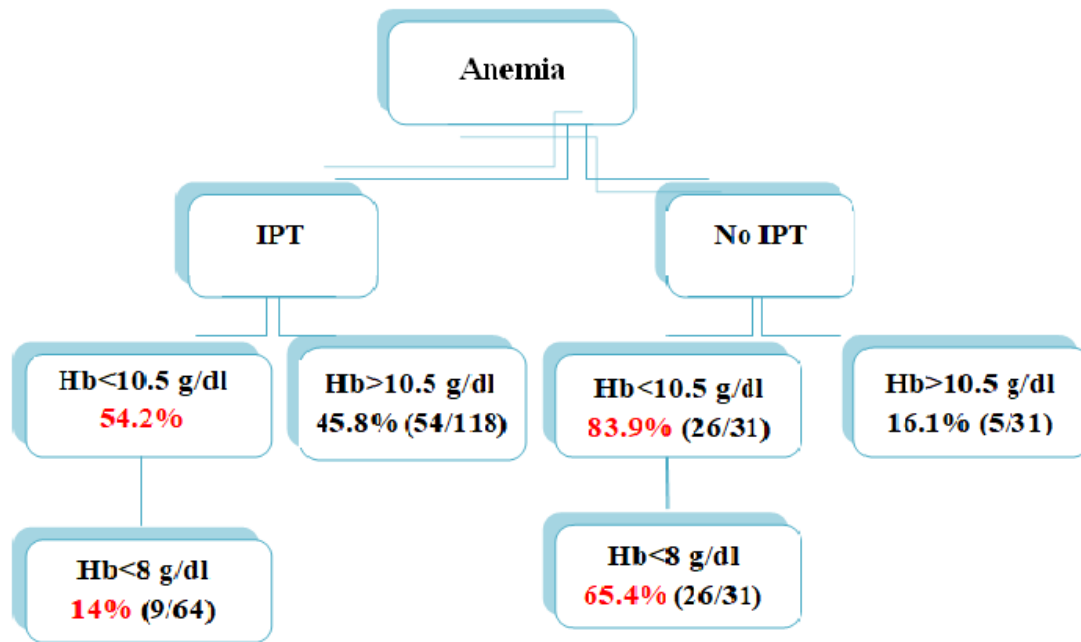


Figure 3: Distribution of anemia in study population

12.1 Anemia and LBW

According to the study findings, in 50% of the cases, the low gestational weight of newborns was observed among anaemic mothers. The risk of low birth weight was found to increase with the severity of anemia in mothers, with 69.2% of newborns born to severely anemic mothers being at risk of low birth weight. However, this difference was not statistically significant ($P = 0.165$).

12.2 Association Between IPTp-SP Doses and Anemia

According to Table 2, the risk of anemia in parturients in this study was found to depend on the number of doses of SP received during the antenatal visit. The study found that the more number of SP dosages the pregnant woman received, the lower the risk of anemia ($OR = 6.18$, 95% CI 2.24 - 17.01; $P < 0.001$). In fact, pregnant women who did not receive any dose of SP were more likely to be anemic than those who had received two doses of SP, but this difference was not statistically significant ($p = 0.17$). However, a significant difference ($p = 0.00000$) was observed between the group of patients who had received zero dose of SP and the group who had taken three doses.

12.3 Association Between IPTp-SP doses and Placental Malaria

The data from Table 2 indicates that pregnant women who did not receive IPTp-SP and gave birth had a higher prevalence of placental malaria (67.7%) in comparison to those who took at least one dose of SP (18.6%). These findings demonstrate that the administration of SP protects against placental malaria with a risk ratio of 0.27. Additionally, the frequency of positive placental malaria was significantly higher in the group of pregnant women who did not receive IPTp-SP in comparison to those who received

at least two ($p = 0.05$) and three doses of SP ($p = 0.02$) (table 2). These results suggest that healthcare providers should prioritize administering SP to pregnant women to prevent placental malaria and improve maternal and fetal health outcomes.

12.4 Association Between IPTp-doses and Low Birth Weight(LBW)

According to Figure 2, low birth weight was observed in 61.3% of neonates born to mothers who did not receive any doses of SP, compared to 25.4% of those who received at least one dose, with a statistically significant difference ($P = 0.012$). Additionally, as shown in Table 2, pregnant women who reported regular administration of multiple doses of SP during ANC had a significantly lower prevalence of newborns with low birth weight at gestational age ($OR = 52.89$, 95% CI 14.74 - 189.81; $P < 0.001$). These results highlight the importance of appropriate antenatal care, including the timely administration of SP, in reducing the risk of low birth weight among neonates and improving maternal and child health outcomes.

12.5 Long-lasting Insecticide-Treated Nets (LLINs) Use

Table 3 shows that there is no significant change in the efficacy of long-acting insecticide-treated mosquito nets, with or without IPTp-SP, regardless of maternal age ($p = 0.85$). However, the administration of IPTp-SP has been shown to offer significant protection against low birth weight (LBW), particularly among pregnant women over the age of 35 (table 3). These results highlight the importance of prenatal consultation, which can improve accessibility to IPTp-SP and ultimately reduce the risk of LBW in newborns. Additionally, the incidence of placental malaria varies with the number of pregnancies, with malaria

attacks during pregnancy resulting in a higher prevalence of low birth weight at gestational age ($p = 0.0007$). These findings underscore the need for appropriate antenatal care, including the use of IPTp-SP, to prevent malaria and improve maternal and child health outcomes. The incidence of low birth weight (LBW) among multiparous women was higher in those who did not receive IPTp-SP compared to those who did. Additionally, irrespective of IPTp-SP administration, multiparous women were found to

be more likely to be anaemic. However, the incidence of positive placental malaria was significantly lower in patients who received IPTp-SP, regardless of parity. Table 3 shows that more than 75% of pregnant women with maternal malaria have delivered LBW newborns, highlighting the importance of appropriate antenatal care and prompt treatment of malaria during pregnancy to improve maternal and child health outcomes.

The relationship between age, ANC, IPTp-SP, use of LLIN and LBW						
Age	<20 years		20-35 years		>35 years	
IPTp-SP Use	IPTp-SP n=30	Nil IPTp-SP n=6	IPTp-SP n=83	Nil IPTp-SP n=23	IPTp-SP n=5	Nil IPTp-SP n=2
Long-acting impregnated mosquito nets	8 (26.7)	2 (33.3)	35 (42.1)	11 (47.9)	3 (60)	1 (50)
Low birth weight.	2 (6.7)	4 (66.7)	22 (26.5)	14 (61.0)	0	1 (50)
Antenatal Consultation	30 (25.4)	0	83 (70.3)	0	5 (4.3)	0
Relationship between Parity, IPTp-SP, LBW, Anemia and Placental Malaria.						
Parity	Primiparous.		Pauciparous		Multiparous	
Usage of IPTp-SP	IPTp-SP n=36	No IPTp-SP n= 8	IPTp-SP n=44	No IPTp-SP n=10	IPTp-SP n=38	No IPTp-SP n=13
Low birth weight	11 (30.5)	4 (50)	10 (25)	4 (40)	9 (23.7)	11 (84.7)
Anemia	22 (61.1)	7 (87.5)	24 (54.5)	7 (70)	25(65.8)	13 (100)
Positive placental malaria (PPM)	7 (19.4)	7 (87.5)	8 (18.1)	6 (60)	7 (18.4)	8 (61.5)

Table 3: Relationship between age, ANC, IPTp-SP, use of LLIN and LBW

13. Discussion

13.1 Socio-Demographic Profile of Pregnant Women

Our study found that 72.5% of pregnant women were between the ages of 20 and 35, with an average age of 25.83 ± 6.15 years. This is consistent with similar studies conducted by Coulibaly et al. in Burkina and Tukur et al. in Nigeria [22,23]. These findings suggest that the age distribution of pregnant women in our study population is comparable to that of other regions in the sub-Saharan African region.

Our study found that more than half (50.3%) of the respondents were housewives. Additionally, 29.5% (31 out of 149) of pregnant women reported receiving zero ANC. These findings are consistent with the literature, which reports that preventive programs delivered through antenatal care (ANC) often face challenges due to late ANC attendance and non-compliance [24]. These challenges highlight the need for increased awareness and education on the importance of ANC and the benefits of preventive interventions for maternal and child health.

Our study found that nearly half (47%) of the pregnant women had completed high school, varying education levels depending on the individual. These findings could be attributed to our study being conducted in a university hospital center, where most women are from urban areas and are likely to be more educated. It is important to note that these results may not represent pregnant women in other regions with different socio-demographic characteristics.

In our study, primiparas and pauciparas who received intermittent preventive treatment with sulphadoxine-pyrimethamine had a 65.1% incidence of positive placental smear for malaria. This finding is consistent with other studies that suggest that multiparas, with previous pregnancies, develop protective immunity against placental malaria infection [25]. Briand et al. also reported similar trends in their studies [26]. These results highlight the importance of targeted interventions for pregnant women, especially primiparas and pauciparas, to prevent the incidence of placental malaria and improve maternal and child health outcomes.

Our study found that the intermittent preventive treatment coverage

rate for pregnant women was 79%, which aligns with the strategic plan for the fight against malaria in Chad between 2011 and 2015. However, we believe that many pregnant women, especially those who are young, poorly immunized, or without IPTp-SP, may not have sufficient information on the benefits of this preventive intervention. This highlights the need for behavior change and communication campaigns to sensitize women of childbearing age to the risks of gestational malaria and the importance of using IPTp-SP and insecticide-treated nets. These campaigns should aim to raise awareness about the dangers of malaria during pregnancy and encourage pregnant women and their families to adopt preventive measures. By increasing knowledge and awareness, we can help to improve the uptake of IPTp-SP and other preventive interventions, ultimately leading to better maternal and child health outcomes.

13.2 Anti-Malaria Procedures

Our study found that 79.19% of pregnant women had attended at least one antenatal care (ANC) visit. Additionally, we observed a significant decrease in peripheral malaria among pregnant women who received at least one dose of sulphadoxine-pyrimethamine during our study. Specifically, 67.7% of pregnant women who did not receive IPTp-SP had a positive thick drop in their peripheral blood sample, compared to only 18.7% of those who received at least one dose of sulphadoxine-pyrimethamine, with a statistically significant difference ($p = 0.001$). These findings are consistent with the literature, which suggests that preventing malaria during pregnancy can help reduce the disease burden [27]. Our results highlight the importance of promoting antenatal care attendance and using preventive measures such as IPTp-SP to improve maternal and child health outcomes.

13.3 Placental Infection

This research article has demonstrated that compliance with the administration of sulphadoxine-pyrimethamine (SP) during pregnancy, at least three doses, effectively protects pregnant women against malaria infection and placental malaria. Specifically, our study found that 21 (67.7%) out of 31 pregnant women who did not receive IPTp-SP had a positive placental smear for Plasmodium at childbirth, compared to 18.6% of those who received at least one dose during their current pregnancy. Our finding of 18.6% in women who received IPTp-SP is higher than that reported in a study conducted in Burkina Faso in 2009 by Gies et al. [28]. These results highlight the importance of appropriate antenatal care, including the timely administration of IPTp-SP, in preventing placental malaria and improving maternal and child health outcomes.

It has been observed in the current study that first-time mothers under intermittent preventive treatment with sulphadoxine-pyrimethamine are still highly susceptible to malaria, with a rate of 19.4%, compared to 18.4% in multipara. However, this difference is not statistically significant ($P = 0.96$), which could be due to a relatively small sample size of the population. It has been reported in the literature that multiparous women who have had previous pregnancies develop protective immunity against

placental malaria infection [25]. It is crucial to evaluate prevention strategies for malaria and placental infection during pregnancy to prevent complications among newborns. Therefore, it is necessary to develop strategies for close monitoring to ensure better adherence to intermittent preventive treatment with sulphadoxine-pyrimethamine during the transmission season, considering the high risk of transmission.

13.4 Low Birth Weight

Low birth weight, which is defined as less than 2500g, is a significant predictor of both children's and maternal health [29]. Our study has found a statistically significant protective effect of administering IPTp-SP against LBW ($P=0.012$), which aligns with previously published literature [30]. This result reinforces the current WHO recommendations that the administration of sulphadoxine-pyrimethamine with intermittent preventive treatment with two to three or more doses should be encouraged in Africa [13].

Our study has found that 32.8% (49/149) of newborns had low birth weight ($P = 0.012$), with a rate of 25.4% in newborns whose mothers used IPT with SP during pregnancy and 61.3% in mothers who did not use IPT. Our study results are better than those reported by Borgella et al. in 2013 [31]. The literature has reported that the beneficial effect of three or more doses of sulphadoxine-pyrimethamine during pregnancy protects against low birth weight [32].

13.5 Anemia

According to our study, anemia was reported in 60.4% of pregnant women. The study found that 83% of pregnant women without IPT-SP compliance suffered from anemia, while only 54.2% of pregnant women on IPT-SP had anemia. Severe anemia was observed in 65.4% of pregnant women who did not receive IPT, while administration of IPT was found to offer protection against anemia. Our results are slightly lower than the study conducted by Omer et al in 2017, which found anemia in 67.7% of pregnant women, with 22 of them (3%) having severe anemia ($Hb < 7$ g/dL) [11]. Although anemia in pregnant women is caused by multiple factors, malaria infection was found to worsen anemia in pregnant women [33].

13.6 Limitations of the Study

Our study has some limitations, one of which is the small sample size. Additionally, this study only considered outcomes in newborns. In future studies, we plan to evaluate the long-term effects on the growth of children born to mothers who tested positive for malaria during pregnancy, both with and without IPTp-SP.

14. Conclusion

The study found that pregnant women who took at least 3 doses of Sulphadoxine Pyrimethamine had less placenta malaria and were better protected against malaria. However, unfortunately, many women did not take the required dosage of Sulphadoxine Pyrimethamine. Malaria in pregnancy has resulted in maternal

anemia and low birth weight in newborns. Sensitization efforts need to be made to increase compliance of pregnant women with preventive programs during antenatal consultations, which will help decrease the complications related to malaria in both mothers and newborns.

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