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Knowledge, uptake and therapeutic effectiveness of sulfadoxine-pyrimethamine (IPTp-SP) among pregnant women attending the antenatal clinic at ayeduase Health Centre in Oforikrom Municipality in the Ashanti-region, Ghana

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Abstract

Background Malaria is a life-threatening disease, and in pregnancy, it has been recognized to pose a substantial threat to mothers, fetuses and neonates and accounted for 249 million malaria cases and 608,000 malaria deaths in 85 countries in 2022. Malaria in pregnancy poses a significant threat, and globally, it is associated with approximately 10,000 maternal deaths each year. In sub-Saharan Africa, it is projected that approximately 25 million pregnant women in this region are at risk of contracting Plasmodium falciparum malaria infection annually. In Ghana, the overall prevalence of malaria in pregnancy was 20.4% among pregnant women in the middle belt of Ghana. Malaria in pregnancy causes maternal anaemia, spontaneous abortion, stillbirth, preterm delivery and low birth weight; however, it is preventable and curable. Despite the implementation of the intermittent preventive treatment with sulfadoxine-pyrimethamine policy in Ghana, the coverage remains low. This study assessed the knowledge, uptake and therapeutic effectiveness of intermittent preventive treatment with sulfadoxine-pyrimethamine among pregnant women visiting the antenatal clinic at the Ayeduase Health Centre.

Methodology The study employed an analytical cross-sectional design, and a total of 187 pregnant women attending the antenatal clinic at the Ayeduase Health Centre were surveyed. The data collected were exported into the Stata Corp 17 version for data analysis. Descriptive statistics were performed, and logistic regression was used to test associations between the dependent and independent variables. A p-value less than 0.05 was considered significant at a 95% confidence level.

Results All pregnant women (100%) had ever heard of IPTp-SP, and 94.7% knew of its benefits in pregnancy. Notably, health providers were the major source of information for approximately 94% of pregnant women, and a higher level

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of knowledge on IPTp-SP was found among 92.0% of pregnant women. The prevalence of anaemia and malaria in pregnancy was found to be low (4.8% and 9.7%, respectively). Optimal uptake (≥ 3 doses) of IPTp-SP was high among (61.3%) pregnant women. Therapeutic effectiveness was high among (86.6%) pregnant women. Late antenatal clinic initiation (AOR = 0.4 95% CI: [0.21–0.89], $p = 0.022$), period of IPTp-SP intake (AOR = 0.1 95% CI: [0.03–0.37], $p < 0.001$), good knowledge (AOR = 6.5 95% CI: [1.06–39.72], $p = 0.043$) and therapeutic effectiveness (AOR = 3.4 95% CI: [1.08-11.0], $p = 0.037$) were significantly associated with ≥ 3 doses of IPTp-SP.

Conclusion The initiation of the antenatal clinic, regular attendance and the uptake of optimal doses of IPTp-SP are crucial elements in ensuring a healthy pregnancy. Educating pregnant women on these aspects is imperative for enhancing their overall well-being and ensuring positive outcomes during pregnancy and childbirth.

Keywords Knowledge, Uptake, Therapeutic effectiveness, Sulfadoxine-pyrimethamine (IPTp-SP), Pregnant women

Background

Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected female Anopheles mosquitoes; fortunately, it is preventable and curable [1]. The most recent World Malaria Report indicated that the year 2021 witnessed 247 million cases of malaria, a slight increase from the 245 million cases recorded in 2020. Additionally, the estimated malaria-related fatalities totalled 619,000 in 2021, slightly lower than the 625,000 reported in 2020 [1].

According to the same report, during the two peak years of the pandemic (2020–2021), disruptions caused by COVID-19 resulted in approximately 13 million additional cases of malaria and 63,000 more malaria-related deaths. By 2022, an estimated 249 million malaria cases and 608,000 deaths were reported across 85 countries [2]. The WHO African Region remains disproportionately burdened by malaria, with approximately 95% of all malaria cases and 96% of deaths occurring in the region in 2021. Notably, children under the age of 5 accounted for approximately 80% of all malaria deaths in this region [1].

Malaria in pregnancy (MiP) poses a significant threat, and globally, it is associated with approximately 10,000 maternal deaths each year [3]. In sub-Saharan Africa, it is projected that annually, approximately 25 million pregnant women are at risk of contracting Plasmodium falciparum malaria infection [4]. MiP represents a significant public health challenge, carrying considerable risks for both mothers and their infants. Annually, MiP contributes to 20% of stillbirths and 11% of all newborn deaths in Sub-Saharan Africa [3]. Despite the potential for asymptomatic malaria during pregnancy, particularly in mothers with high acquired immunity in areas of high transmission, it remains linked to elevated risks for various complications for both the mother and the developing fetuses. These include maternal anaemia, spontaneous abortion, stillbirth, preterm delivery and low birth weight (LBW) [4, 5]. Additionally, severe maternal anaemia escalates the risk of maternal mortality and is estimated to contribute to as many as 115,000 maternal deaths annually in Africa [6]. This underscores the multifaceted impact of malaria during pregnancy and emphasizes the importance of addressing and mitigating its consequences for maternal and infant health.

Among some African countries, MiP women attending antenatal care (ANC) were found to be 41.6% and 7.7% in Nigeria, 13.7% in Eastern Sudan, 18.1% in Burkina Faso and 19% in Malawi [4]. Additionally, in Ethiopia, the prevalence was reported to be between 2.83% and 16.3% [7]. Malaria is endemic and perennial in Ghana, hence making the country among the 15 countries with the highest burden of malaria globally [8]. A malaria report by the National Malaria Control Programme found a prevalence of 17.6% among pregnant women attending outpatient departments (OPDs) in Ghana [9]. Additionally, the overall prevalence of MiP was found to be 20.4% among pregnant women in the middle belt of Ghana [10]. In Ghana, some regions reported MiP to be 14.1% from RDT tests and 13.4% using PCR in the northern region [11], 17.1% and 19.0% in the Ashanti region [12, 13], 26.1% in the western region [14] and 20.9% in the central region [15].

Over the past decade, significant gains have been made in the implementation of malaria prevention measures in pregnancy in sub-Saharan Africa, including the distribution of insecticide-treated nets (ITNs) and the uptake of sulfadoxine-pyrimethamine (SP) for pregnant women. Consequently, this has shown a great impact on the reduction of the incidence of malaria and its adverse outcomes, such as maternal anaemia, stillbirths and intrauterine growth restriction [16, 17].

In the Ghanaian setting, numerous interventions have been rolled out to reduce malaria prevalence in pregnancy. Notably, Intermittent Preventive Treatment with Sulfadoxine-Pyrimethamine (IPTp-SP) uptake and the continuous distribution of insecticide-treated nets (ITNs) during antenatal care sessions were implemented. Ghana adopted the revised WHO IPTp-SP policy implementation, which recommends a minimum of 3 doses of IPTp-SP under directly observed therapy (DOT), as enshrined in the WHO policy guidelines for implementation [18].

The policy also emphasized the relevance of the first dose uptake in the second trimester and subsequently every month until the time of delivery [19]. A minimum uptake of three doses of SP during pregnancy minimizes the chances of encountering the consequences of MiP [20]. Despite the implementation of the IPTp-SP policy in Ghana, the coverage remains low [21]. This outcome not only affects the mother and the unborn baby but is also a barrier to the achievement of Sustainable Development Goal 3 targets 1, 2 and 3 to reduce maternal and neonatal mortality and to end malaria infection by 2030 [22].

In the Ghanaian setting, research has been conducted in the area of IPTp-SP uptake and its predictors [19, 23, 24]. However, there is no evidence-based assessment of the uptake and effectiveness of IPTp-SP among pregnant women visiting ANC at the Ayeduase Health Centre in the Ashanti region of Ghana. This makes it nearly impossible to adopt local strategies to improve its uptake. By assessing the uptake and effectiveness of IPTp-SP in preventing malaria during pregnancy among women attending this health facility, the study contributes significantly to the understanding of the intervention's relevance and provides a basis for implementing targeted interventions. The findings not only offer insights for addressing existing challenges but also serve as a valuable resource for devising facility-specific strategies to enhance the utilization of IPTp-SP. Therefore, this study assessed the knowledge, uptake and therapeutic effectiveness of IPTp-SP among pregnant women visiting antenatal clinics at the Ayeduase Health Centre. This makes it essential to unearth and understand the factors serving as obstacles to ending the endemicity of malaria in pregnancy. The ramifications of this research surpass the boundaries of the Oforikrom Municipality in the Ashanti Region of Ghana. Instead, it resonates with the intention to amplify the efficacy and effectiveness of IPTp-SP, with a concerted effort to broaden its coverage and magnify its positive impact on maternal and child health.

Methodology

Study setting and Context

Ayeduase is located in the north of Kumasi and is approximately 5 km from the KNUST Junction, Accra Rd, Kumasi. It shares a common boundary with Kotei, KNUST, Deduako, Denyase, Emena and Ayigya. It has a population of approximately twenty-three thousand, nine hundred and forty-four (23, 944). Out of this population, 5747 (24%) are women of fertility age (WIFA). It is under the administration of the Oforikrom Municipal and the traditional authority headed by the chief of Ayeduase, who is subservient to the gold stool of Ashanti. The Ayeduase Health Centre is the main primary healthcare facility providing health services for the populace within and around Ayeduase [25]. This facility provides outpatient department services, family planning, antenatal and postnatal care, eye care services, and laboratory and delivery services. The facility has a staff strength of 62, including physician assistants, nurses, midwives, other healthcare practitioners and auxiliary staff.

Ghana is endemic to malaria, and the Ashanti Region is one of the hotspots for malaria. The Ayeduase community is no exception [26]. Among all OPD cases, the facility records a high number of malaria cases [25]. Hence more funds are allocated to help in the control of malaria infections [27].

Study Design, Population and Sample size

An analytical cross-sectional study design was employed in this study. The study was conducted between July and September 2023. This study involved ANC mothers aged 18 years and above in their second and third trimesters visiting the Ayeduase Health Centre. Based on the antenatal clinic attendance records, a total population of 297 was recorded. A sample size for this study was calculated using Yamane's (1967) formula [28], considering a 95% confidence level (corresponding to a Z-value of 1.96), a significance level of 5%, and a precision error of 5%.

$\mathrm{n} = \frac{N}{1+N(e)2}$

where n = estimated sample size.

Z = standard normal variate at 95% confidence interval, which corresponds to 1.96.

N = the total population (297) of mothers in their 2nd and 3rd trimesters, as recorded in the ANC register.

e = precision error

$$n = \frac{297}{1 + 297\,(0.05)^2}$$

$$n = \frac{297}{1 + 297\,(0.0025)}$$

$$n = \frac{297}{1 + 0.7425)}$$

$$n = \frac{297}{1.7425}$$

$n = 170.44$.

With a 10% nonresponse rate, $(0.10 \times 170 + 170)$ a minimum sample size of 187 pregnant women was recruited in this study.

Sampling technique

A simple random sampling technique was employed in the selection of pregnant ANC attendees for participation in this study. From the ANC register, a comprehensive sampling frame was created, incorporating all

eligible pregnant mothers attending ANC at the Ayeduase Health Centre. This frame was constructed through collaboration with the healthcare facility and the health workers.

Each pregnant mother in the sampling frame was assigned a unique identification number, and these numbers were written on slips of paper. The slips were then placed in a container and mixed thoroughly, and one slip was drawn without looking. The identification number on the slip drawn was recorded, and the first participant was selected. This method was repeated throughout the study until the desired sample size was achieved. The recruitment process encountered refusals from some selected mothers; however, they were replaced. This ensured that each participant had an equal chance of being chosen, making it a straightforward and fair method for selection. Before selection into the study, pregnant mothers were provided with comprehensive information about the study's purpose, procedures, and potential implications.

Inclusion and exclusion criteria

The study included all pregnant women aged 18 years and above in their second and third trimesters who sought ANC at the Ayeduase Health Centre. Emphasis was placed on the voluntary nature of participation and informed consent. ANC attendants who consented to participation during the period of the study were surveyed. Those who declined consent and those who were sick were excluded from the study.

Definition of variables

Outcome Variable

The variable optimal dose of IPTp-SP was the outcome variable for this study. This variable was discrete, and it assessed whether pregnant women had received 1 dose, 2 doses, 3 doses, 4 doses and 5 doses of IPTp-SP. This was further categorized into <3 doses and ≥ 3 doses in relation to the WHO-recommended doses of IPTp-SP [18]. ≥ 3 doses of IPTp-SP doses were classified as optimal uptake of IPTp-SP. The MCH record books were used to confirm and assess the IPTp-SP doses received by each pregnant woman.

Explanatory variable

For this study, four (4) explanatory variables were considered in our estimation. These variables included demographic factors, maternal obstetric factors, knowledge on IPTp-SP and therapeutic effectiveness of IPTp-SP. They were chosen based on the literature from previous works. Demographic factors captured 5 items (age, marital status, level of education, employment status and religious affiliation). Maternal obstetric factors captured 8 items (number of live births, number of pregnancies, ANC visits and period of ANC initiation in previous and current pregnancies, period of IPTp-SP initiation, doses received and period in pregnancy received). Six (6) items were used to measure maternal knowledge on the IPTp-SP. Regarding knowledge, a composite variable was generated to assess overall knowledge on the IPTp-SP. A mean score was used to categorize knowledge into 1= "good knowledge" and 0= "poor knowledge". A score above the mean was considered good knowledge, and a score below the mean was considered poor knowledge. Finally, therapeutic effectiveness was measured with two variables, "experienced malaria or not" and "experienced anaemia or not", when IPTp-SP was initiated. It was further classified as 0= "experienced either malaria or anaemia infection" and 1= "no experience of either malaria or anaemia infection". A composite variable was generated to measure the overall therapeutic effectiveness of IPTp-SP. A score above the mean was considered 1= "High Effectiveness", and a score below the mean was considered 0= "Low Effectiveness".

Malaria and anemia infections

In our study, we collected malaria and anaemia data from the Maternal and Child Health (MCH) record book. To ensure accuracy, we cross-checked this information by querying pregnant women about any signs or symptoms of malaria or anaemia during the initiation of IPTp-SP. Laboratory-confirmed test results recorded in the MCH books were also used. For malaria diagnosis, either a rapid diagnostic test (RDT) or blood film test was used, while anaemia was based on recorded haemoglobin (HB) reports from the books. The WHO criteria, HB levels below 110 g/L [29] was classified as anaemic, ensuring a rigorous and reliable basis for our analysis.

Data collection, instrument and management

Data Collection process

Two well-trained research assistants were recruited for data collection from ANC mothers. An electronic-based questionnaire (KoboCollect) was used in this study. KoboCollect is a secure web application for building and managing online surveys and databases. The database has a mobile application that was installed on a smartphone for each data collector. This application allows for offline data capture (i.e., data collection is possible even without internet access). Subsequently, the data were uploaded to the online server upon the availability of the internet. The questionnaire for this study was administered by an interviewer. English, twi and fante languages were used to solicit information from study participants. Participants were assured of confidentiality and that identifiable information such as names would not be disclosed in any way. This was done to ensure that participants were free to express themselves without fear. The purpose, risks and benefits involved in the study were verbally explained

to the participants as part of the informed consent process. A form was given to individuals who agreed to participate in the study to either sign or thumbprint before the interview. The study was pretested before formal commencement.

Validity/reliability of the instrument

Validity was ensured by piloting the study among 10% of the sample size through the administration of questionnaires. Piloting was performed to gain feedback on the questionnaire and to have adequate knowledge of the structure of the questionnaire for appropriate adjustments to be made if necessary. Afterwards, the research team made adjustments to the questionnaire to ensure that the items measured what it intended to measure. The instrument's reliability was ensured by performing a Cronbach's alpha (α) test for internal consistency, and a value between 0.7 and higher was deemed acceptable [30]. The study utilized 19 items in the tool with a scale reliability coefficient (α) value of 0.7.

Data management and statistical analysis

All data collected from participants for this study were declared research data. No identifiable data were obtained from the participants. All quantitative data were first stored in the KoboCollect database with restricted assessment. Data were downloaded and saved on a password-protected protected drive. Only the research team has access to these data.

Data cleaning, validation and analysis were performed using MS Excel and Stata Corp 17.0 version. Categorical data are presented using summarized frequencies and percentages, normally distributed continuous variables are summarized using means and standard deviations, and skewed continuous data are summarized using medians and interquartile ranges. A chi-square test was conducted to assess the association between the dependent variable (IPTp-SP uptake) and the independent variables. Significant variables were then included in a bivariate analysis (Model I) to identify factors predicting IPTp-SP uptake. In the final Model II, multivariate logistic regression was employed, where only significant variables from Model I were adjusted to further evaluate the strength of the association between the explanatory and dependent variables. Statistical significance was considered at a 5% alpha level.

Table 1 Demographic characteristics of respondents n= (187)

Variable	Frequency(*n*)	Percentage (%)
Age group (years)		
18–20	13	7.0
21–30	82	43.9
31+	92	49.2
Mean [SD]	**30[± 5.88]**	
Marital status		
Married	145	77.5
Cohabiting	42	22.5
Educational status		
No formal education	9	4.8
Primary	10	5.4
JHS	70	37.4
SHS	55	29.4
Tertiary	43	23.0
Employment status		
Unemployed	35	18.7
Employed	128	68.5
Housewife	17	9.1
Student	7	3.7
Religious affiliation		
Christianity	153	81.8
Muslim	30	16.1
Traditionalist	4	2.1

Results

Demographic characteristics of respondents

A total of 187 pregnant women participated in the study. The results revealed that the majority 92 (49.2%) were 31 years and above. The mean age was 30 years and the SD = ± 5.88. More than half (145, 77.5%) of them were married, and educational status revealed that most of them (70, 37.4%) had completed JHS. More than half 128 (68.5%) were employed, and the religious affiliation of 153 (81.8%) of them was Christianity (Table 1).

Maternal obstetric characteristics

The majority 114 (61.0%) of the pregnant women reported having ≤ 2 live births, and slightly above half 95 (50.8%) had 3–4 pregnancies. From previous pregnancies, more than two-thirds 176 (94.1%) had attended ANC visits 4 times or more, and above half 109 (58.3%) initiated their first ANC within their 1st trimester of pregnancy. In their current pregnancy, more than half 111 (59.4%) initiated their first ANC visits in their 1st trimester, 57 (30.5%) initiated theirs in the 2nd trimester and the remaining 19 (10.1%) initiated it in the 3rd trimester. Almost all respondents 186 (99.5%) had received at least a dose of IPTp-SP in their current pregnancy, and out of them, a high proportion 166 (89.3%) took their first dose of IPTp-SP in their 2nd trimester, and the remaining 20 (10.8%) took theirs in the 3rd trimester (Table 2).

Respondents' knowledge on IPTp-SP

Evaluating the knowledge of pregnant women regarding IPTp-SP, every one of the 187 pregnant women (100%) had previous awareness of IPTp-SP. The majority (177, 94.7%) correctly identified IPTp as a medication for preventing malaria during pregnancy. Approximately 56

Table 2 Maternal obstetric characteristics (*n* = 187)

Variable	Frequency (*n*)	Percentage (%)
Number of live births		
≤ 2	114	61.0
3–4	67	35.8
5+	6	3.2
Number of pregnancies		
≤ 2	61	32.6
3–4	95	50.8
5+	31	16.6
ANC visit in the previous pregnancy		
< 4	11	5.9
≥ 4	176	94.1
First ANC initiation in your previous pregnancy		
1st Trimester	109	58.3
2nd Trimester	78	41.7
First ANC visit during the current pregnancy		
1st Trimester	111	59.4
2nd Trimester	57	30.5
3rd Trimester	19	10.1
Received IPTp-SP during this pregnancy		
No	1	0.5
Yes	186	99.5
Period in pregnancy IPTp-SP was taken (*n* = 186)		
2nd Trimester	166	89.3
3rd Trimester	20	10.8

Table 3 Knowledge of respondents on IPTp-SP n= (187)

Variable	Frequency (*n*)	Percentage (%)
Heard of IPTp-SP		
Yes	187	100
No	0	0
What IPTp-SP is		
A drug for the prevention of malaria in pregnancy	177	94.7
A drug given to pregnant women at the ANC clinic	10	5.3
Least dose of IPTp-SP taken during pregnancy		
One time	1	0.5
Two times	7	3.7
Three times	56	30.0
Four times	41	21.9
Five times	82	43.9
Tablets of SP taken at once		
Two	1	0.5
Three	186	99.5
Period into pregnancy to start taking IPTp-SP		
1–3 Months	0	0
4–6 Months	187	100

(30.0%) accurately recognized the WHO-recommended minimum doses of IPTp, which is three doses. Nearly all 186 participants (99.5%) were aware that three tablets of IPTp-SP should be taken simultaneously under direct observation. The knowledge was unanimous among all respondents (100%) that the second trimester is the appropriate period during pregnancy to initiate the intake of IPTp-SP (Table 3).

Sources of information on IPTp-SP

From Fig. 1 below, the sources of information on IPTp-SP are presented. The findings showed that 94.0% of respondents reported that healthcare providers were their major source of information on IPTp, and approximately 4.5% also stated that radio/television was their source of information. Friends/relatives/neighbours were the least reported source of information to (0.5%) of respondents.

Respondents' knowledge level on IPTp-SP

Assessing the knowledge level of respondents on the IPTp-SP, the results showed that a higher proportion of 172 (92.0%) had good knowledge, while a few 15 (8.0%) had poor knowledge on the IPTp-SP (Fig. 2).

IPTp-SP doses among pregnant women

Doses of IPTp-SP received among pregnant women are presented below. The results showed that 13 (7.0%) had received a single dose of IPTp-SP, 59 (31.7%) had received 2 doses, 65 (35.0%) had received 3 doses, 34 (18.3%) had received 4 doses and 15 (8.1%) had received 5 doses. Furthermore, the majority 114 (61.3%) had received the minimum recommended doses of IPTp-SP (3 doses), and the remaining 72 (38.7%) had not received the minimum recommended doses of IPTp-SP (Fig. 3).

Therapeutic effect of IPTp-SP among pregnant women

Regarding malaria incidents during IPTp-SP administration, about 168 (90.3%), reported not experiencing malaria. However, it is noteworthy that 18 (9.7%) of them reported having experienced malaria despite adhering to the IPTp-SP regimen. Similarly, with anaemia about 177 (95.2%) pregnant women did not have anaemia while a small proportion 9 (4.8%) did. In all, the therapeutic effectiveness of IPTP-SP was high among 161 (86.6%) of them who did not have either malaria or anaemia infections, while the effect was low among 25 (13.4%) (Fig. 4).

Factors associated with optimal uptake of IPTp-SP

Factors predicting optimal uptake of IPTp-SP are presented in Table 4 below. Age group, marital status, number of live births, number of pregnancies, number of previous ANC visits, period of first ANC initiation in previous pregnancy and knowledge were statistically

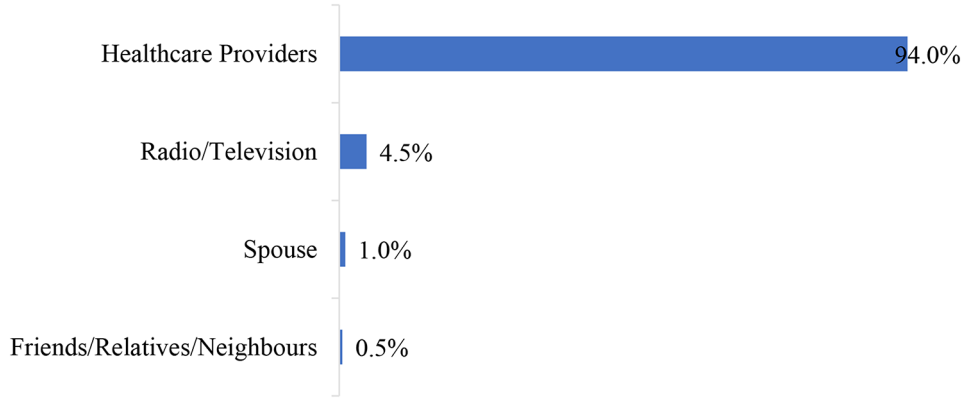

Fig. 1 Percentage Distribution of Sources of Information on IPTp-SP

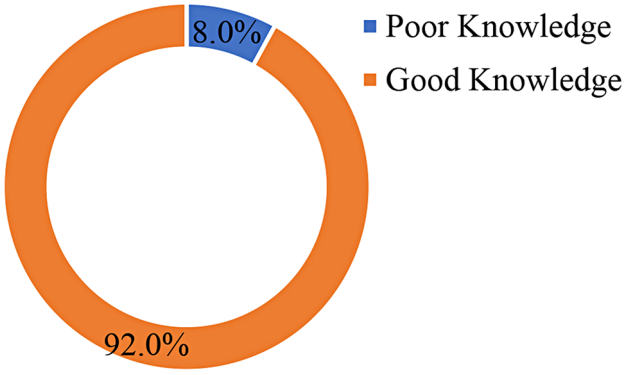

Fig. 2 Percentage Distribution of Respondents' Knowledge Level on IPTp-SP

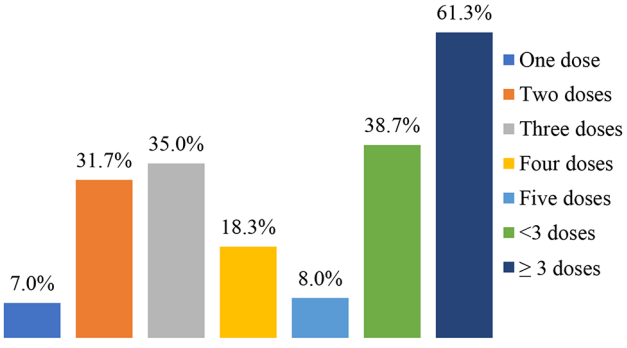

Fig. 3 Percentage distribution of IPTp-SP Uptake

significant predictors of the optimal uptake of IPTp-SP ($p < 0.05$).

However, after controlling for covariates, significant predictors of IPTp-SP uptake included the number of pregnancies, timing of the first ANC visit, IPTp-SP intake during the current pregnancy, knowledge of IPTp-SP, and its therapeutic effectiveness ($p < 0.05$). Pregnant women with five or more children were 9.5 times more likely to have optimal IPTp-SP uptake (AOR = 9.5, 95% CI: [1.30-69.15], $p = 0.026$). Those who initiated their first ANC visit in the 2nd or 3rd trimester had lower odds of receiving ≤ 3 doses of IPTp-SP (AOR = 0.4, 95% CI: [0.21–0.89], $p = 0.022$), and those who started IPTp-SP intake in the 3rd trimester had significantly lower odds of uptake (AOR = 0.1, 95% CI: [0.03–0.37], $p < 0.001$). Women with good knowledge were 6.5 times more likely to take the optimal doses (AOR = 6.5, 95% CI: [1.06–39.72], $p = 0.043$). Additionally, IPTp-SP's therapeutic effectiveness was 3.4 times higher among those who had taken three or more doses (AOR = 3.4, 95% CI: [1.08-11.0], $p = 0.037$).

First ANC visit, period of IPTp-SP initiation and therapeutic effectiveness of IPTp-SP

A high therapeutic effectiveness of IPTp-SP was found among 67.1% of pregnant women who adhered to receiving three or more doses. However, a small proportion, 6 women (24.0%), failed to receive the optimal number of doses. The timing of the first ANC visit and the trimester when IPTp-SP was initiated were statistically significant ($p < 0.05$). IPTp-SP effectiveness was low among women who initiated ANC visits in the 3rd trimester (COR = 0.04, 95% CI: [0.02–0.13], $p < 0.001$). Additionally, its effectiveness in preventing malaria was also low for women who began IPTp-SP in the 3rd trimester (COR = 0.06, 95% CI: [0.02–0.16], $p < 0.001$). After controlling for covariates, the likelihood of IPTp-SP being therapeutically effective was lower for women who initiated ANC visits late in the 3rd trimester, as their chance of receiving three or more doses was significantly reduced (AOR = 0.07, 95% CI: [0.02–0.23], $p < 0.001$) (Table 5).

Discussion

Findings on respondents' knowledge on IPTp revealed that (100%) pregnant women had ever heard of IPTp. This finding was consistent with a study conducted in the Volta Region, Ghana [31]. A high proportion of them (94.7%) correctly knew that IPTp-SP was a drug for preventing malaria in pregnancy, and this finding was similar to a study conducted in Ghana and Tanzania [14, 32].

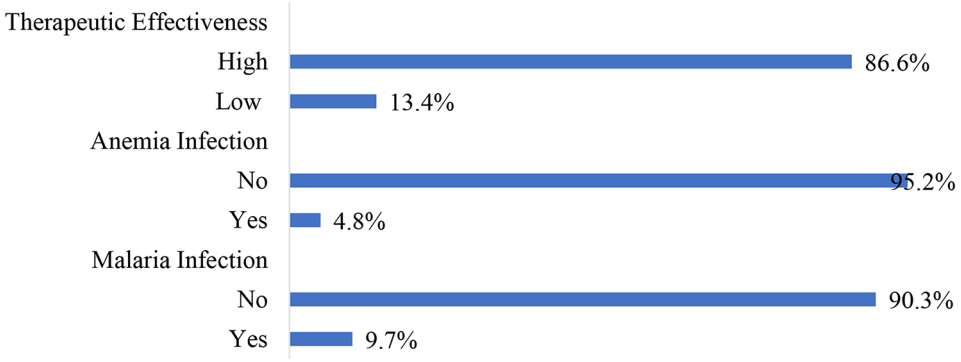

Fig. 4 Therapeutic Effect of IPTp-SP

About (30.0%) of them were able to identify WHO recommended least doses (3 doses) of IPTp-SP, and this was in correlation with a study in Somalia [33]. Health providers were the major source of information on IPTp-SP, and this finding was similar to a study conducted in Somalia [33]. Adequate knowledge (92.0%) on IPTp-SP was found in this study and the finding resonates with those in Tanzania and Somalia [33, 34]. This may reflect the influence of healthcare providers who offer accurate information to help clients make informed decisions about their health during pregnancy. In contrast, poor knowledge of IPTp-SP was reported among pregnant ANC attendants in Nigeria [35]. This reflection may be due to variations in geographical location.

The study found that a majority (61.3%) of pregnant women had received ≥ 3 doses of IPTp-SP. This suggests a promising trend, indicating that a significant proportion of pregnant women who were part of the study remained malaria-free while undergoing the prescribed treatment. However, a high prevalence (79.6%) of IPTp-SP uptake was reported in Western Kenya compared to this study [36]. The high prevalence rates could be a result of a high level of client satisfaction among pregnant women who received IPTp-SP services during their ANC visits within the domain of the study. Partial adherence to IPTp-SP was identified among 38.7% of pregnant women receiving fewer than three doses. Higher partial adherence was reported from Uganda where 69.0% failed to meet the recommended dosage [37]. Also in Nigeria, only 17% of pregnant women took the recommended three or more doses of IPTp-Sp [38]. Other African countries, such as Cameroon (47.0%), Malawi (29.8%), and Tanzania (48.4%), have also reported low optimal uptake [34, 39, 40]. In Ghana, some regions have similarly reported partial adherence rates in the Northern region (42.4%), Tema metropolis (46.6%), Kintampo (32.4%), and the Volta region (57.8%) [14, 41–43]. The low adherence rates may be attributed to barriers such as limited access to antenatal care, challenges within the health system, lack of awareness, and socio-economic constraints as reported in some studies [35, 44]. Tackling these issues is essential for improving IPTp-SP uptake and protecting the health of both mothers and their unborn children to achieve SDG 3 targets 1 and 2 [45].

Optimal doses of IPTp-SP uptake were high among pregnant women aged 30 years and above. This was consistent with a study conducted in Ghana [43]. This could be because older women may have gained enough information on malaria in pregnancy and the benefits of IPTp-SP from previous regular antenatal visits, influencing their decision-making. This study suggests efforts in curbing teenage pregnancy should be strengthened. Being married was linked to optimal IPTp-SP. The findings corroborated a study in Tanzania and Ghana [43, 46]. These reflections could be attributed to the emotional encouragement and support married women receive from their spouses during pregnancy, hence male involvement is crucial in ANC. Multiparous women were more likely to receive optimal doses of IPTp-SP. The finding was in line with a study in Ghana [47]. This could be attributed to the experienced benefits of IPTp-SP in pregnancy and childbirth outcomes among these pregnant women in their previous pregnancies. Increased number of ANC visits (4 times or more) increased the chances of optimal IPTp-SP doses. This finding resonates with those conducted in Malawi, Tanzania and Ghana [34, 39, 47]. This implies that regular ANC visits frequently expose pregnant women to health educational information on IPTp-SP by health providers, and this could influence their decision-making during pregnancy. Despite increased ANC attendance, its timely initiation is crucial, since late initiation was associated with reduced IPTp-SP uptake in this study. This finding is consistent with a study in Ghana and Western Kenya [14, 36]. This implies early initiation of ANC provides pregnant women with an opportunity to receive more doses of IPTp-SP compared to those who initiate ANC late in their 3rd trimester. This study suggests that health workers should actively encourage pregnant women to initiate ANC early, ideally during the first trimester of pregnancy. Optimal doses of

Table 4 Factors associated with optimal uptake of IPTp-SP

Variables	IPTP-SP Usage			Model I	Model II
	< 3= [72] *n* (%)	≥3 = [114] *n* (%)	Chi-square X^2	COR (95% CI), *p*-value	AOR (95% CI), *p*-value
Sociodemographic factors					
Age group (years)			**< 0.001***		
18–20	9(12.5)	4(3.5)		**Ref**	**Ref**
21–30	40(55.6)	41(36.0)		2.3(0.65–8.09),0.192	0.7(0.13–4.06),0.722
31+	23(31.9)	69(60.5)		***6.7(1.90–24.0),0.003**	0.7(0.09–5.74),0.778
Marital status			**< 0.001***		
Cohabiting	26(36.1)	16(14.0)		**Ref**	**Ref**
Married	46(63.9)	98(86.0)		***3.5(1.69–7.07),0.001**	1.3(0.44–4.20)0.758
Educational status			0.287		
No formal education	1(1.4)	8(7.0)		**Ref**	
Primary	4(5.6)	6(5.3)		0.2(0.02–2.14), 0.178	
JHS	32(44.4)	37(32.5)		0.14(0.02–1.22),0.075	
SHS	20(27.8)	35(30.7)		0.2(0.25–1.88),0.166	
Tertiary	15(20.8)	28(24.6)		0.2(0.03–2.05),0.189	
Employment status			**0.002***		
Unemployed	17(23.6)	17(14.9)		**Ref**	
Employed	41(56.9)	87(76.3)		2.1(0.98–4.57),0.055	
Housewife	7(9.7)	10(8.8)		1.4(0.44–4.6),0.552	
Student	7(9.7)	0(0)		1	
Religious affiliation			0.341		
Christianity	56(77.8)	96(84.2)		**Ref**	
Muslim	15(20.8)	15(13.2)		0.6(0.27–1.28),0.180	
Traditionalist	1(1.4)	3(2.6)		1.8(0.18–17.23),0.632	
Maternal Obstetric Factors					
Number of live births			**< 0.001***		
< 3	59(81.9)	54(47.4)		**Ref**	**Ref**
3–4	11(15.3)	56(49.1)		***5.6(2.64–11.70), < 0.001**	1.7(0.55–5.51), 0.341
5+	2(2.8)	4(3.5)		2.2(0.38–12.41), 0.378	0.9(0.04–05.91),0.924
Number of pregnancies			**< 0.001***		
< 3	39(54.2)	22(19.3)		**Ref**	**Ref**
3–4	28(38.9)	66(57.9)		***4.2(2.11–8.28), < 0.001**	2.7(0.99–7.36),0.052
5+	5(6.9)	26(22.8)		***9.2(3.10-27.43), < 0.001**	**9.5(1.30-69.15),0.026***
Number of ANC visits in previous pregnancy			**0.017***		
< 4	8(11.1)	3(2.6)		**Ref**	**Ref**
≥ 4	64(88.9)	111(97.4)		***4.6(1.18–18.06), 0.028**	2.3(0.03–2.28),0.224
First ANC initiation in the previous pregnancy					
1st Trimester	33(45.8)	75(65.8)	**0.007***	**Ref**	**Ref**
2nd Trimester	39(54.2)	39(34.2)		***0.4(0.24–0.80), 0.008**	0.9(0.37–2.27),0.842
First ANC visit in this pregnancy					
1st Trimester	28(38.9)	82(72.8)	**< 0.001***	**Ref**	**Ref**
2nd Trimester	29(40.3)	28(24.6)		***0.3(0.17–0.64), < 0.001**	***0.4(0.21–0.89),0.022**
3rd Trimester	15(20.8)	4(3.5)		***0.1(0.03–0.30), < 0.001**	0.9(0.17–2.27),0.642
Initiated IPTp-SP					
2nd Trimester	56(77.8)	110(96.5)	**< 0.001***	**Ref**	**Ref**
3rd Trimester	16(22.2)	4(3.5)		***0.1(0.04–0.40), < 0.001**	***0.1(0.03–0.37), < 0.001**
Had malaria					
Yes	13(18.1)	5(4.4)	**0.002***	**Ref**	**Ref**
No	59(81.9)	109(95.6)		***4.8(1.63–14.12), 0.004**	0.1(0.01–4.14),0.206
Had anaemia			**0.014***		
Yes	7(9.7)	2(1.8)		**Ref**	**Ref**
No	65(90.3)	112(98.3)		***6.0(1.21–29.82), 0.028**	1.2(0.01-7.0),0.370

Table 4 (continued)

Variables	IPTP-SP Usage			Model I	Model II
	< 3= [72] *n* (%)	≥3 = [114] *n* (%)	Chi-square X^2	COR (95% CI), *p*-value	AOR (95% CI), *p*-value
Knowledge on IPTp-SP			**< 0.001**		
Poor	13(18.1)	2(1.75)		**Ref**	**Ref**
Good	59(81.9)	112(98.3)		***12.3(2.69–56.51), 0.001**	**6.5(1.06–39.72),0.043***
Therapeutic Effectiveness			**< 0.001**		
Low	19(76.0)	53(32.9)		**Ref**	**Ref**
High	6(24.0)	108(67.1)		***6.5(2.43–7.01), < 0.001**	***3.4(1.08-11.0), 0.037**

Statistically significant associations at 95% CI (two-tailed),$p < 0.05$, AOR: adjusted odds ratio, COR: crude odds ratio, Ref: Reference

Table 5 First ANC visit, period of IPTp-SP initiation and therapeutic effectiveness of IPTp-SP

Variables	Therapeutic Effectiveness			Model I	Model II
	Low [25] *n* (%)	High [161] *n* (%)	Chi-square (x^2) *p*-value	COR (95% CI), *p*-value	AOR (95% CI), *p*-value
First ANC visit			< 0.001*		
1st Trimester	7(28.0)	103(64.0)		**Ref**	**Ref**
2nd Trimester	6(24.0)	51(31.7)		0.6(0.18–1.80), 0.346	0.6(0.18–1.77),0.329
3rd Trimester	12(48.0)	7(4.4)		***0.04(0.02–0.13), < 0.001**	***0.07(0.02–0.23), < 0.001**
Initiated IPTp-SP			**< 0.001***		
2nd Trimester	13(52.0)	153(95.0)		**Ref**	**Ref**
3rd Trimester	12(48.0)	8(5.0)		***0.1(0.02–0.16), < 0.001**	0.01(0.01–0.08),0.215

* Statistically significant associations at 95% CI (two-tailed),$p < 0.05$, AOR:adjusted odds ratio, CSOR: crude odds ratio, Ref: Reference

IPTp-SP were less among pregnant women who experienced malaria and anaemia during pregnancy. These findings resonate with a study conducted in Ghana and Tanzania [14, 48]. This study suggests additional malaria prevention strategies, such as the use of long-lasting insecticidal nets (LLINs) should be echoed too. Good knowledge regarding IPTp-SP increased its usage. This was corroborated by a study conducted in Tanzania [34], and Western Kenya [36]. The study suggests that enhanced education on IPTp-SP using various channels is crucial.

Receiving three or more doses of IPTp-SP was protective against malaria and anaemia, as supported by a study in Ghana [14]. The prevalence of malaria in pregnancy (MiP) was low at 9.7%, significantly lower than rates observed in northwest Ethiopia (20.8%) and Ghana (20.3%) [49, 50]. Anaemia prevalence was recorded at 4.8%, while higher rates were noted in other studies: 41.5% in Sunyani [51] and 60.3% in the Volta region [50]. The low prevalence of MiP in this study may be linked to high IPTp-SP utilization and variations in the study settings. Late initiation of ANC in the third trimester was linked to lower odds of IPTp-SP effectiveness among pregnant women and it was consistent with findings in Tanzania [34]. This study suggests more health education during ANC sessions highlights the importance of early ANC visits and IPTp-SP intake. Similarly, a study in Ghana reported a reduced likelihood of malaria and anaemia among pregnant women who received three or more doses of SP [47]. These findings support the effectiveness of appropriate SP dosing in reducing malaria risk and improving birth weight. Therefore, the National Malaria Control Programme (NMCP) and the Ghana Health Service (GHS) should implement interventions to sustain and enhance IPTp-SP uptake.

Implication for practice

Nurses and midwives play a crucial role as key sources of information on IPTp-SP for pregnant women. To enhance service delivery, the Ministry of Health and Ghana Health Service should provide additional education and in-service training focused on malaria in pregnancy. Ongoing educational initiatives must highlight the importance of regular and early ANC initiation, as this is essential for mitigating the severe health risks malaria poses to pregnancy and improving birth outcomes. Strengthening these programs, particularly in malaria-endemic areas, is vital for maternal and newborn health. Additionally, the healthcare system should be made more accessible and welcoming to encourage higher ANC attendance. Male involvement is also important, given that marital status significantly influences IPTp-SP uptake among married women. Finally, future research should conduct the study in a broader context at the community level to be able to assess the magnitude of the problem and to help develop targeted strategies to increase coverage and utilization.

Strengths and limitations of the study

The strength of this study lies in its cross-sectional design, which provided a snapshot of IPTp-SP uptake and

therapeutic effectiveness among pregnant women attending ANC at the Ayeduase Health Centre. This design allowed for a broad overview of IPTp-SP use, enabling the generation of hypotheses and forming a baseline understanding of its uptake. The study also gathered verbal reports from participants on their experiences with malaria and anaemia, which were cross-verified with documented test results from the Maternal and Child Health (MCH) record book. However, the data recorded in the MCH record book may have temporal limitations, as it represents a specific time frame. To mitigate this, recent test results were used to capture more current changes, providing a more up-to-date and accurate reflection of the findings.

Conclusion

Our study highlights the significant benefits of early ANC initiation and optimal use of IPTp-SP among pregnant women. It shows that early ANC visits and timely IPTp-SP administration result in higher doses, which effectively reduce the risks of malaria and anaemia. These improvements are linked to enhanced maternal health and well-being. Importantly, the findings underscore the pivotal role of health education in encouraging these behaviours, ultimately supporting global efforts toward achieving Sustainable Development Goal 3 by 2030.

Abbreviations

ANC	Antenatal care
AOR	Adjusted Odds Ratio
COR	Crude Odds Ratio
DOT	Directly Observed Therapy
GHS	Ghana Health Service
ITNs	Insecticide-Treated Nets
IPTp	Intermittent Preventive Therapy
LBW	Low Birth Weight
MiP	Malaria in Pregnancy
NMCP	National Malaria Control Programme
OPD	Out Patient Department
IPTp	Intermittent Preventive Treatment
SP	Sulfadoxine-Pyrimethamine
SDG	Sustainable Development Goal
WHO	World Health Organization
WHO	AFRO-World Health Organization African Region
MCH	Maternal and Child Health

Supplementary Information

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Supplementary Material 1

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Author contributions

DA: Conceived the study, data collection and assisted with manuscript revision. DMO: Conceptualization of the study, performed statistical analysis, interpretation of findings, manuscript preparation, reviewing and revision of the manuscript.VM: Contributed to the study design, supervised the study and reviewed and revised the manuscript.All authors have read and approved the final version of the manuscript for submission.

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Data availability

The dataset produced and analysed in the course of this study is accessible upon request from the corresponding author.

Declarations

Ethics approval and consent to participate

Ethical clearance was granted by the UNIPORT Research Ethics Committee and the Ghana Health Service Research Ethics Committee. Additionally, approval was obtained from the relevant regional health directorates and local health facilities participating in the study. Prior to inclusion, participants were not subjected to any form of coercion, and their decision to participate or abstain was made without any adverse consequences. The study adhered to the principles outlined in the Declaration of Helsinki. Informed consent was obtained from each participant in languages including Twi, Fante, and English. Participants aged 18 and above were approached for permission, and their endorsement was indicated through either a signature or a thumbprint.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Clinical trial number

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