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Impact of knowledge, attitudes, practices, and perceptions on the effectiveness of intermittent preventive treatment with sulfadoxine-pyrimethamine among pregnant women in the Dschang Health District, Cameroon

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Abstract

Malaria during pregnancy is a significant public health concern in countries with limited resources, such as Cameroon. The effectiveness of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) may be influenced by behavioral, cognitive, and contextual factors. This study examined the impact of pregnant women's knowledge, attitudes, practices, and perceptions on the effectiveness of IPTp-SP in the Dschang Health District in Cameroon. An analytical, retrospective, cross-sectional study was conducted among 249 pregnant women who received at least three doses of IPTp-SP between January and December 2021 at two major healthcare facilities. Data were collected using a structured questionnaire. Statistical analyses included chi-square tests, Spearman's correlation, and multivariate logistic regression. The mean age of the participants was 26.75±5.08 years. Despite receiving three or more IPTp-SP doses, the incidence of malaria during pregnancy remained high at 37.35%. Factors independently associated with malaria occurrence were irregular use of long-lasting insecticidal nets (LLINs; p=0.001), lower malaria knowledge scores (p=0.009), and low parity. Primiparous and secundigravidae women were the most affected (p=0.012). Frequent LLIN use significantly reduced the risk of infection (adjusted odds ratio [AOR]=2.75; 95% confidence interval [CI]: 1.51-5.00). Behavioral factors, particularly consistent LLIN use and adequate malaria knowledge, play a key role in improving IPTp-SP effectiveness. Strengthening counseling during antenatal care could improve malaria prevention among pregnant women.

Key words: IPTp-SP; malaria in pregnancy; knowledge, attitudes; practices; perceptions, LLINs; maternal health; Cameroon.

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Introduction

Malaria remains one of the leading causes of morbidity and mortality in Sub-Saharan Africa, particularly among pregnant women, whose susceptibility to infection increases due to pregnancy-related immunological changes.[1,2] According to the World Health Organization, Africa accounts for approximately 94% of global malaria cases and 95% of malaria-related deaths, making pregnant women a key high-risk group.[1] Malaria in pregnancy is associated with maternal anemia, placental infection, low birth weight, preterm delivery, and increased neonatal mortality.[2] To reduce the burden of malaria in pregnancy, intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) is recommended during antenatal care as a key strategy to prevent maternal and neonatal complications.[3] IPTp-SP has been shown to significantly reduce maternal anemia, placental malaria, low birth weight, and neonatal mortality.[4,5] In Cameroon, IPTp-SP remains the cornerstone of malaria prevention in pregnancy, yet coverage and adherence remain suboptimal, with only about 39% of pregnant women receiving at least three doses, as reported by recent national surveys.[6] Despite its proven efficacy, the effectiveness of IPTp-SP varies considerably across settings because it depends not only on drug pharmacodynamics but also on multiple behavioral and programmatic factors. Poor knowledge of malaria, inadequate use of long-lasting insecticidal nets (LLINs), low adherence to antenatal care schedules, misconceptions about SP safety, and limited counseling during antenatal care visits significantly reduce the protective effect of IPTp-SP.[7,8]

In Cameroon, malaria remains a leading cause of outpatient consultations, hospital admissions, and maternal morbidity, with the West Region being one of the most affected areas. Despite national guidelines promoting IPTp-SP as a routine component of

antenatal care, several studies have reported persistent challenges, including late initiation of care, inconsistent SP stock availability, misconceptions about drug safety, and inadequate counseling during antenatal care visits.[9-11] Given these programmatic and behavioral challenges, understanding how pregnant women's knowledge, attitudes, practices, and perceptions influence malaria outcomes is essential for improving the impact of IPTp-SP in high-transmission settings such as the Dschang Health District (Cameroon). This study, therefore, aimed to assess the relationship between knowledge, attitudes, practices, and perceptions and the effectiveness of IPTp-SP among pregnant women who delivered in 2021, while adopting a One Health perspective that considers the interplay between human behavior, healthcare delivery, and environmental factors in malaria transmission.

Materials and Methods

Study design and setting

This study was an analytical retrospective cross-sectional survey conducted from April to June 2022 in the Dschang Health District, located in the West Region of Cameroon. The district is characterized by perennial malaria transmission with seasonal peaks during the rainy period and comprises both urban and semi-rural areas with heterogeneous utilization of antenatal care services. Two major healthcare facilities providing maternal and child health services were purposively selected because of their high antenatal care attendance and volume of deliveries.

Study population and eligibility criteria

The study population consisted of pregnant women who delivered between January and December 2021 in the two selected healthcare facilities of the Dschang Health District. Eligible participants were women who had attended antenatal care services in the same facilities and had complete obstetric records, including documentation of IPTp-SP doses received during pregnancy. Women were included if they had received at least one dose of IPTp-SP and provided informed consent to participate in the study.

Women were excluded if they had incomplete antenatal care or delivery records, uncertain recall of malaria episodes, or any medical condition that could interfere with the assessment of malaria outcomes, such as chronic anemia unrelated to malaria or documented hemoglobinopathies.

Sample size and determination

The minimum required sample size was calculated using the Cochran formula for single proportions: $n=Z^2P(1-P)/d^2$.

where "Z" is the standard normal deviate corresponding to a 95% confidence interval (CI; 1.96), "p" is the expected prevalence of malaria in pregnancy or IPTp-SP effectiveness in similar settings, and "d" is the margin of error (0.05).

Based on previous studies in Cameroon reporting a malaria prevalence of approximately 20% among pregnant women, a value of p=0.20 was used. After adjusting for non-response, the final sample size was rounded to 249 participants, which was achieved during data collection.

Sampling technique

A consecutive sampling technique was used to recruit participants. All eligible pregnant women who delivered in the two selected healthcare facilities between January and December 2021 were approached and invited to participate until the required sample size was reached.

Data collection

Data were collected from April to June 2022 using a structured and pre-tested questionnaire administered through face-to-face interviews with eligible women after delivery. The questionnaire captured sociodemographic characteristics, obstetric history, malaria prevention practices, use of IPTp-SP, antenatal care attendance, and self-reported episodes of malaria during pregnancy. Additional information, including the number and timing of IPTp-SP doses, hemoglobin levels, and recorded malaria diagnoses, was extracted from antenatal care and delivery records using a standardized data extraction form.

Data collectors were trained before the study to ensure consistency in administering the questionnaire and collecting data from medical records. All questionnaires were checked daily for completeness and accuracy, and any inconsistencies were corrected in real time through verification with the healthcare facility registers or participant follow-up where necessary.

Variable measurement

The main outcome variable was the occurrence of malaria during pregnancy, defined as any malaria episode documented in the antenatal or delivery records or self-reported by the participant and confirmed by the health facility. The effectiveness of IPTp-SP was assessed based on the number of doses received and the presence or absence of malaria during pregnancy.

Independent variables included: i) socio-demographic characteristics: age, marital status, education level, occupation, and residence; and ii) obstetric characteristics: gravidity, parity, gestational age at first antenatal care visit, and number of antenatal care visits. IPTp-SP uptake: i) number of SP doses received, timing of administration, and adherence to antenatal care schedule; ii) malaria prevention practices: frequency of LLIN use (always, often, occasionally, never), use of other preventive methods, and environmental risk factors; iii) knowledge variables: knowledge of malaria transmission, symptoms, prevention, and consequences during pregnancy, scored using a composite knowledge index; and iv) attitudes and perceptions: perceived susceptibility to malaria, perceived benefits and safety of IPTp-SP, and trust in antenatal care services, measured using Likert-scale items.

Knowledge, attitudes, practices, and perceptions were categorized into "good" or "poor" based on mean or median scores, depending on distribution. All variables were coded and entered into the statistical database for analysis.

Data analysis

Data was analyzed using SPSS version 22.0 and Epi Info version 7.2.2.6. Descriptive statistics were used to summarize participants' sociodemographic and obstetric characteristics. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as means with standard deviations.

Bivariate analysis was performed using chi-square tests (or Fisher's exact test when appropriate) to examine the relationship between independent variables and the occurrence of malaria during pregnancy. Spearman's rank correlation was used to assess relationships between continuous or ordinal variables such as knowledge, attitudes, and practices scores.

Variables with $p \leq 0.20$ in bivariate analysis were included in a multivariate logistic regression model to identify independent pre-

dictors of malaria during pregnancy. Adjusted odds ratios (AORs) with their 95% CIs were calculated. Statistical significance was set at $p<0.05$. Data was checked for completeness, inconsistencies, and missing values prior to analysis. Coding and recoding procedures were performed systematically to ensure accuracy and reliability.

Ethical considerations

The study received ethical approval from the Regional Committee for Health Research Ethics of the West Region (Ref: 0123/CRERSH-O/2022). Administrative authorization was obtained from the Dschang Health District and the participating healthcare facilities. Written informed consent was obtained from all participants prior to enrollment. Confidentiality and anonymity were strictly maintained throughout the study.

Results

Sociodemographic characteristics

A total of 249 women were included in the study. The mean age was 26.75±5.08 years (range: 17-40). The most represented age group was 20-25 years (42.17%). More than half of the participants had a university education (54.62%), while 42.57% had a secondary education. Most women were married (53.82%). Regarding parity, primiparous women accounted for 36.55% of the sample, followed by secundigravidae (23.69%), women with a third pregnancy (19.68%), and those with four or more pregnancies (20.08%) (Table 1).

Knowledge about malaria

Most participants (81.53%) correctly identified mosquito bites as the primary cause of malaria, and fever was the most commonly recognized symptom (80%). Regarding prevention, 89.56% reported LLINs as the main preventive method. Overall, 49.40% of participants had a medium level of knowledge about malaria (Figure 1).

Preventive practices

The most frequently used malaria prevention method was LLINs (69.08%), followed by environmental cleaning (19.28%), mosquito spray (5.62%), and indoor residual spraying (3.61%). However, only 65.06% of LLIN owners reported sleeping under a net every night, while 16.06% never used a net. The main reason for non-regular use was discomfort (67.79%) (Table 2)

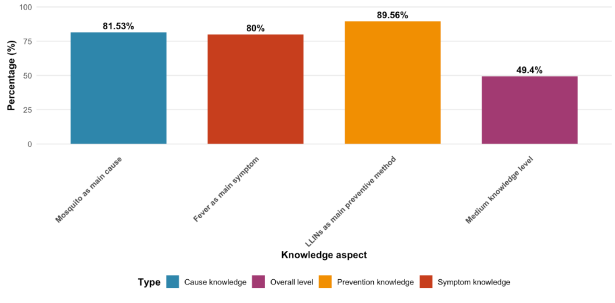

Figure 1. Knowledge of malaria causes.

IPTp-SP effectiveness and influencing factors

The incidence of malaria during pregnancy was 37.35% (93/249). Malaria cases peaked during the second trimester (44.09%) (Table 3). In multivariate logistic regression analysis, several factors were independently associated with IPTp-SP effectiveness. Regular LLIN use significantly reduced the risk of malaria (AOR=2.75; 95% CI: 1.51-5.00; p=0.001). Higher frequency of LLIN use was also protective (AOR=1.89; 95% CI: 1.32-2.71; p=0.001). Women with higher malaria knowledge levels were less likely to experience malaria during pregnancy (AOR=2.12; 95% CI: 1.21-3.72; p=0.009). Parity was also significant, with primiparous and secundigravidae women representing 29.3% and 32.6% of malaria cases, respectively (p=0.012). Age >25 years showed a modest but significant association with lower malaria risk (p=0.012) (Table 3). Table 4 presents the results of multivariate analyses. Independent factors significantly influencing IPT effectiveness included regular LLIN use (AOR=2.75; 95% CI: 1.51-

Table 1. Sociodemographic characteristics of participants (n=249).

Variable	Frequency (n)	Percentage (%)
Age group (years)		
15-19	16	6.43
20-25	105	42.17
26-30	64	25.70
31-35	51	20.48
36-40	13	5.22
Education level		
Primary	7	2.81
Secondary	106	42.57
University	136	54.62
Parity		
Primiparous	91	36.55
Secundigravida	59	23.69
Third pregnancy	49	19.68
≥ Fourth pregnancy	50	20.08

Table 2. Preventive practices against malaria (n=249).

Preventive practice	Frequency (n)	Percentage (%)
Main method		
LLINs	172	69.08
Environmental cleaning	48	19.28
Mosquito spray	14	5.62
Indoor residual spraying	9	3.61
Others	6	2.41
LLIN use frequency		
Every day	162	65.06
2 nights/week	19	7.63
3 nights/week	28	11.24
Never	40	16.06

LLIN, long-lasting insecticidal net.

Table 3. Timing of malaria occurrence during pregnancy.

Pregnancy period	Number of cases (n)	Percentage (%)
1st trimester (first 3 months)	20	21.51
2nd trimester (first 6 months)	41	44.09
3rd trimester (last 3 months)	32	34.41
Total	93	100

5.00; p=0.001), frequency of LLIN use (p=0.001), knowledge level about malaria (p=0.009), and parity (p=0.012). Primiparous and secundigravidae women accounted for 29.3% and 32.6% of malaria cases, respectively. In the multivariate logistic regression model, an AOR less than 1 indicates a protective effect. Regular LLIN use reduced malaria risk by 64% (AOR=0.36; 95% CI: 0.20-0.66), while a high knowledge level reduced risk by 53% (AOR=0.47; 95% CI: 0.27-0.83).

Discussion

The present study assessed knowledge, attitudes, practices, and IPTp-SP effectiveness among pregnant women in the Dschang Health District. Malaria incidence during pregnancy remained high (37.35%), with the highest proportion of cases occurring during the second trimester. Although most participants demonstrated good knowledge of malaria transmission and prevention, gaps persisted in the adoption of consistent preventive practices. While LLIN ownership was high, only two-thirds of users slept under a net every night. Multivariate analysis showed that regular LLIN use, higher knowledge levels, and parity were independent predictors of IPTp-SP effectiveness, underscoring the importance of both behavioral and obstetric factors in malaria prevention.

The malaria incidence observed in this study aligns with findings from other regions of Cameroon, where pregnancy-related malaria remains a persistent health concern. In the West Region, similar transmission levels were reported by Walker-Abbey *et al.*[10] Comparable prevalence patterns have also been documented across Central Africa, including studies from Gabon and the Democratic Republic of Congo,[11,12] confirming that malaria in pregnancy remains substantial in the sub-region.

The high level of malaria-related knowledge observed among participants is consistent with previous Cameroonian studies, where most women attending antenatal care services correctly identified mosquito bites as the main cause of malaria.[15] However, as in our findings, several authors highlight discrepancies between knowledge and practice, particularly regarding LLIN use, which remains inconsistent because of discomfort, heat, or misconceptions.[16] The protective effect of regular LLIN use is also supported by a recent study, which demonstrates that consistent LLIN utilization significantly reduces malaria among pregnant women and that actual use, rather than ownership, is the key determinant of protection.[13,14,17] Similarly, higher levels of knowledge have been associated with improved adherence to IPTp-SP and LLIN use, resulting in better maternal outcomes in Sub-Saharan Africa.[18]

The findings of this study highlight the critical role of behavioral determinants in IPTp-SP effectiveness. Although knowledge of malaria was generally high, inconsistent LLIN use suggests that awareness alone is insufficient to ensure adequate prevention. Barriers such as heat, discomfort, and household constraints may contribute to reduced adherence, as documented in similar studies. The higher vulnerability of primiparous and secundigravidae women may be linked to immunological immaturity or limited experience with antenatal care services. Moreover, the fact that higher knowledge scores were associated with lower malaria risk underscores the importance of strengthening health education and counseling during antenatal care visits. Tailoring preventive messages to younger and less experienced mothers could help improve overall IPTp-SP effectiveness. This study has several strengths. The use of validated antenatal care records improved the accuracy of IPTp-SP dosage documentation and malaria episode verification. In addition, the application of multivariate logistic regression allowed the identification of independent predictors of malaria during pregnancy. However, some limitations should be considered. The retrospective cross-sectional design does not allow causal inference. The reliance on self-reported information for preventive practices may have introduced recall or social desirability bias. Furthermore, the study was conducted in only two healthcare facilities, which may limit the generalizability of the findings. Despite these limitations, the results highlight the importance of strengthening counseling during antenatal care visits, particularly to promote consistent LLIN use and improve malaria prevention among younger and primiparous women.

Table 4. Multivariate analysis of factors influencing IPTp-SP effectiveness.

Factor	AOR	95% CI	p
LLIN use (yes *vs* no)	0.36	0.20-0.66	0.001
LLIN use frequency/week	0.53	0.37-0.76	0.001
Knowledge level (high *vs*low)	0.47	0.27-0.83	0.009
Parity (primiparous *vs* multiparous)	0.57	0.36-0.88	0.012
Age group (>25 years *vs* ≤25 years)	0.65	0.46-0.91	0.012

AOR, adjusted odds ratio; CI, confidence interval; LLIN, long-lasting insecticidal net; OR <1 indicates protective effect; OR >1 indicates increased risk.

Limitations and strengths

This study has several limitations. Firstly, its cross-sectional design does not allow for the establishment of causal relationships. Secondly, the use of non-probabilistic sampling may affect the representativeness of the results. The absence of molecular data on resistance to SP in parasites also constitutes a gap. Nevertheless, the robust sample size, high participation rate (81.64%), and multivariate analytical approach enhance the internal validity of the results. From a One Health perspective, our study emphasizes the importance of incorporating environmental factors into prevention strategies. Contextual factors such as housing conditions, environmental sanitation, and the proliferation of breeding sites influence exposure to mosquito vectors. A combined approach involving drug-based prevention (IPTp-SP), personal protection (LLINs), and environmental management could enhance the effectiveness of interventions against gestational malaria.

Conclusions

This study highlights the ongoing impact of malaria on pregnant women in the Dschang Health District, despite high levels of awareness. While most participants demonstrated adequate knowledge of malaria transmission and prevention, inconsistent adoption of preventive behaviors, particularly the regular use of LLINs, significantly limited the effectiveness of IPTp-SP. Independent predictors of better malaria outcomes included higher levels of knowledge, regular LLIN use, and parity, emphasizing the important role of behavioral and obstetric factors in malaria prevention.

Therefore, improving counseling during antenatal care, ensuring the continuous availability of SP and adapting preventive messages for younger and primiparous women could significantly enhance the effectiveness of IPTp-SP. From a One Health perspective, integrating environmental and community-based strategies to reduce exposure to mosquito vectors could further improve maternal health outcomes.

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Conflict of interest: the authors have no conflict of interest to declare.

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Availability of data and materials: the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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