

# Predictors for the Uptake of Optimal Doses of Sulfadoxine-pyrimethamine for Intermittent Preventive Treatment of Malaria During Pregnancy in Tanzania: Further Analysis of 2015-2016 Tanzania Demographic and Health Survey and Malaria Indicator Survey Data

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## Research

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# Abstract

**Background:** In Tanzania, the uptake of optimal doses ( $\geq 3$ ) of sulfadoxine-pyrimethamine for intermittent preventive treatment of malaria (IPTp-SP) during pregnancy has remained below the recommended target of 80%. Therefore, this study aimed to investigate the predictors for the uptake of optimal IPTp-SP among pregnant women in Tanzania.

**Methods:** This study used data from the 2015-16 Tanzania demographic and health survey and malaria indicator survey (TDHS-MIS). The study had a total of 4,111 women aged 15 to 49 who had live births 2 years preceding the survey. The outcome variable was uptake of three or more doses of IPTp-SP and the independent variables were age, marital status, education level, place of residence, wealth index, occupation, geographic zone, parity, the timing of first antenatal care (ANC), number of ANC visits and type of the health facility for ANC visits. Predictors for the optimal uptake of IPTp-SP were assessed using univariate and multivariable logistic regression.

**Results:** A total of 327 (8%) women had optimal uptake of IPTp-SP doses. Among the assessed predictors, the following were significantly associated with optimal uptake of IPTp-SP doses; education level [primary (AOR: 2.2, 95% CI 1.26–3.67,  $P=0.005$ ); secondary or higher education (AOR: 2.1, 95% CI 1.08–4.22,  $P=0.029$ )], attended ANC at the first trimester (AOR: 2.4, 95% CI 1.20–4.96,  $P=0.014$ ), attended  $\geq 4$  ANC visits (AOR: 1.9, 95% CI 1.34–2.83,  $P<0.001$ ), attended government health facilities (AOR: 1.5, 95% CI 1.07–1.97,  $P=0.017$ ) and geographic zone [Central (AOR: 5, 95% CI 2.08–11.95,  $P<0.001$ ); Southern Highlands (AOR: 2.8, 95% CI 1.15–7.02,  $P=0.023$ ); Southwest Highlands (AOR: 2.7, 95% CI 1.03–7.29,  $P=0.043$ ); Lake (AOR: 3.5, 95% CI 1.51–8.14,  $P=0.004$ ); Eastern (AOR: 1.5, 95% CI 1.88–11.07,  $P=0.001$ )].

**Conclusions:** The uptake of optimal IPTp-SP doses is still low in Tanzania. The optimal uptake of IPTp-SP was associated with attending ANC in the first trimester, attending more than four ANC visit, attending government health facility for ANC, having primary, secondary or higher education level and geographic zone. Therefore, we recommend health education and behavior change interventions with the emphasis on the optimal use of IPTp-SP doses.

## Background

Malaria in pregnancy is still a major public health problem causing maternal, fetus and neonatal adverse health effects such as spontaneous abortion, maternal anemia, stillbirth, premature birth, low birth weight and maternal death (1). Among the *Plasmodium* species; *Plasmodium falciparum* is the leading cause of maternal illness and low birth weight due to malaria especially in Africa (2). The estimates showed that 125 million pregnant women are at risk of acquiring malaria globally with 10,000 maternal death and 200,000 neonatal death annually as a result of malaria in pregnancy (3). Also, malaria accounts for 18% of severe anemia in pregnancy (4). The occurrence of malaria in pregnancy has been associated with low

gestational age, low maternal age, low parity, non-uptake of SP during pregnancy, level of knowledge on malaria prevention, place of residence of a woman and household wealth status (5, 6).

The World Health Organization recommends interventions such as the use of intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) and folic acid supplementation as a part of antenatal care services to prevent and treat malaria and anemia during pregnancy in areas with moderate to high malaria transmission. However, the IPTp-SP should be combined with the use of insecticide treated nets (ITNs) and effective case management of malaria (2). SP uptake starts in the second trimester and pregnant women should receive at least 3 doses with an interval of one month during the pregnancy (7). The evidence shows that the scale-up of malaria prevention interventions (IPTp and ITNs) in 25 malaria endemic African countries has lowered neonatal mortality and low birth weight by 18% and 21% respectively (3).

Tanzania is one of the malaria-endemic countries with approximately 1.7 million pregnant women at high risk of malaria infection (8). The trend of malaria prevalence among pregnant women in Tanzania has been fluctuating with the highest of 10.3% in 2014 and the lowest of 6.8% in 2017 (9). It was observed that despite the low prevalence of malaria in some areas such as in Zanzibar Island, 0.8% of the pregnant women had malaria parasitemia during delivery (10).

Tanzania decided to opt for IPTp-SP policy in 2001 and for the revised policy of using  $\geq 3$  doses of IPTp-SP in 2013. The Tanzania demographic and health survey and malaria indicator survey of 2015/16 has reported the uptake of sulfadoxine-pyrimethamine (SP) among pregnant women to be 68% for the first dose, 35% for the second dose and 8% for the third dose (11). The uptake of optimal doses (at least three or more doses) of SP among pregnant women in Tanzania is still low compared to required optimal coverage of at least 80% (3). The low coverage of IPTp-SP was also observed in sub-Saharan Africa with the median coverage of 64%, 38% and 23% for first, second and third doses respectively (12). The use of less than recommended doses of SP is less beneficial in prevention of maternal and fetus/neonatal adverse health effects as it has been proven that the use of three or more doses to have beneficial effects against malaria related health effect to both of maternal and fetus/neonatal (1).

Globally, studies have reported potential determinants associated with the uptake of at least two doses of SP to be; age of a woman, place of residence, education level of a woman, household social-economic status, knowledge of a woman about malaria and IPTp-SP, number and timing of antenatal care (ANC) visit (12–17). It was observed that educated and wealthier women were knowledgeable about IPTp and more likely to receive the SP (18). Also, the uptake of SP was higher for women who attended 3 to 4 ANC visit and started ANC visit in their first or second trimester compared to those who started at third trimester (13, 16, 17). The predictors for the uptake of optimal ( $\geq 3$ ) IPTp-SP doses for malaria prevention in Tanzania have not been fully investigated. Therefore, this study aimed to analyze the predictors for the uptake of the optimal doses of SP among pregnant women who gave birth 2 years preceding the 2015-16 TDHS-MIS. The findings shall inform the policymakers and programmes implementers on the necessary changes to be done to improve the uptake of SP to optimal doses as recommended by the WHO.

## Methods

### Study design and data source

This study was a cross-sectional study utilizing the TDHS-MIS dataset of 2015-16. This was a sixth in a series of nationally representative household surveys conducted in Tanzania. It was conducted from August 2015 to February 2016 to provide up to date data on the areas of health, population (demographics) and nutrition. It was done under collaboration of Demographic and Health Surveys programme, National Bureau of Statistics, Office of Chief Government Statistician and Ministries of health in Tanzania Mainland and Zanzibar.

### Study Population And Sample Size

The study population was women of reproductive age (15–49) who had a live birth in the two years before the survey. The data was extracted from women individual recode file (TZIR7BFL) which had a total sample size of 4,128 women who gave birth two years preceding the survey. However, 17 women were dropped because of incomplete information on the outcome variable. Therefore, the total sample size used for this study was 4,111 women (unweighted sample) and 4056 women (weighted sample).

### Sampling Technique

The 2015-16 TDHS-MIS employed stratified two-stage cluster sampling. The first stage involved the selection of clusters contained enumeration areas in which 608 clusters were selected. The second stage involved the systematic selection of the households from the 608 selected clusters in which 22 households were selected in each cluster. This sampling technique produced a probability sample of 13,376 households whereby only 12,767 households were occupied. In the occupied households, a total number of 13,266 women were interviewed and out of the interviewed women, 4,128 gave birth two years before this survey. Hence, they were eligible for inclusion in this study (11).

### Measurement Of Variables

The variables associated with uptake of IPTp were extracted from women's data set based on the literature review. The outcome variable was uptake of three or more doses of IPTp-SP. The explanatory variables were socio-demographic characteristics (age, marital status, level of education, place of residence, geographical zone of residence, wealth status) and obstetric characteristics (parity, timing of first ANC visit, number of ANC visits and type of health facility used for ANC services). The summary of variable definitions and categories are shown in Table 1.

Table 1  
Variables extracted and used for this study

Variable	Definition	Categories
<b>Outcome variable</b>		
Uptake of IPTp-SP	Three or more doses of doses of IPTp-SP is optimal.	< 3 doses  ≥ 3 doses (optimal)
<b>Explanatory variables</b>		
Age	Woman's age group	15–19  20–24  25–29  30–34  35–39  40–44  45–49
Marital status	Woman's marital union status	Never in union  In union  No longer in union
Education level	Woman's highest level of education	No formal education  Primary education  Secondary education and beyond
Place of residence	Area or place where a woman was residing	Urban  Rural
Occupation	Woman's occupation	Unemployed  Self-employed  Employed

<b>Variable</b>	<b>Definition</b>	<b>Categories</b>
Wealth index status	Household's wealth index from which a woman is coming	Poorest Poor Middle Rich Richest
Parity	Number of live births that a woman had ever had	1 2 3+
Timing of 1st ANC visit	Gestational age (pregnancy) age in months at which a woman visited ANC for first time	First trimester Second trimester Third trimester
Number of ANC visits	Number of ANC visits a pregnant women made during her gestation period	1–3 4+
Type of facility for ANC visit	Type of ownership of a facility (Government or non-government) that a woman was attending for ANC	Non-government Government
Geographical zone	Geographical zone from which a woman was residing	Western Northern Central Southern highlands Southern South west highlands Lake Eastern Zanzibar

## Data Management And Analysis

The data was extracted, cleaned and analyzed using STATA version 14 (STATA Corp, College Station, Tx, USA). Descriptive statistics analysis was first conducted on socio-demographics and obstetric characteristics to obtain frequencies and proportions. Chi-square test was carried out to describe the association between explanatory variables (socio-demographic/obstetric variables) and the outcome (the optimal uptake of IPTp-SP) at a significance level of 5%. Then, binary logistic regression (univariate) was conducted to all variables with statistical significant in chi-square test and results were reported as crude odds ratio. All explanatory variables with a P-value < 0.25 on univariate analysis were subjected to multivariable logistic regression for further analysis of association to obtain adjusted odds ratios. To account for the differences in sampling probabilities across the clusters and strata, we used the sample weighted to adjust for the cluster sampling design.

## **Ethical Consideration**

This study used secondary data without involving any human subjects. Therefore, no formal ethical approval was required. However, the Tanzania Demographic and Health survey was conducted after approval from national and international review boards including the National Institute of Medical Research, Zanzibar Medical Research Ethical Committee, Institutional Review Board of Inner City Fund and the Centers for Disease Control and Prevention in Atlanta. All women interviewed were requested to provide verbal informed consent before the commencement of the study. The permission to use the IPTp-SP data was sought and obtained from the DHS program.

## **Results**

### **Socio-demographic characteristics of the study respondents**

This study included 4,111 women, majority (27.3%) were between the ages of 20–24 years. The majority of the respondents (75.9%) lived in rural areas and 83% were in a union. More than half of the respondents (59.6%) had attained primary education and 51.4% were self-employed. Also, the highest number of respondents came from the regions of Lake Zone (27.4%) and belonged to the poorest wealth quintile (22.5%) as shown in Table 2.

Table 2  
Socio- demographic characteristics of the study respondents (n = 4111)

<b>Socio-demographic variable</b>	<b>Frequency(n)</b>	<b>Percentage (%)</b>
<b>Age (years)</b>		
15–19	480	11.7
20–24	1124	27.3
25–29	978	23.8
30–34	715	17.4
35–39	518	12.6
40–44	245	6
4–49	51	1.2
<b>Marital status</b>		
Never in union	311	7.6
In union	3413	83
No longer in union	387	9.4
<b>Education level</b>		
No formal education	795	19.3
Primary	2450	59.6
Secondary+	866	21.1
<b>Place of residence</b>		
Urban	991	24.1
Rural	3120	75.9
<b>Wealth index status</b>		
Poorest	927	22.5
Poorer	828	20.1
Middle	780	19
Richer	888	21.6
Richest	688	16.7
<b>Occupation</b>		



<b>Socio-demographic variable</b>	<b>Frequency(n)</b>	<b>Percentage (%)</b>
Unemployed	818	19.9
Self-employed	2113	51.4
Employed	1180	28.7
<b>Geographic zone</b>		
Western	408	10
Northern	306	7.4
Central	420	10.2
Southern highlands	280	6.8
Southern	151	3.7
South west highlands	457	11.1
Lake	1128	27.4
Eastern	373	9.1
Zanzibar	588	14.3

## **Distribution Of Socio-demographic Characteristics By Optimal Uptake Of Iptp-sp**

There was a significant association between the optimal uptake of SP doses (3 or more doses) and woman's education level ( $p = 0.0003$ ), place of residence ( $p = 0.0002$ ), wealth index status ( $p = 0.0002$ ), occupation ( $p = 0.0326$ ), and geographical zone ( $p < 0.0001$ ). The optimal uptake of IPTp-SP doses increased by level education ranging from 3.9% for women with no formal education to 10.7% for women with secondary and above the secondary level of education. For the place of residence, more women in the urban areas (11.6%) took optimal doses of IPTp-SP as compared to women in rural areas (6.7%). For the wealth index, the results show that the richest women (13.1%) took more optimal doses of IPTp-SP as compared to the poorest women (6%). For the geographical zone, the uptake of optimal doses of IPTp-SP was lowest in the Western zone (2.1%) and highest in the Eastern zone (15.3%) as presented in Table 3.

Table 3  
Distribution of socio-demographic characteristics by optimal uptake of IPTp-SP

Socio-demographic variable	Total n (weighted)	Women took 3 + doses (Weighted)		p-value
		Count (%)	95% CI	
<b>Overall</b>	4056	327 (8.1)	7.0-9.3	
<b>Age (years)</b>				
15-19	531	35 (6.5)	4.5-9.5	
20-24	1,114	102 (9.1)	7.3-11.3	0.5292
25-29	963	67 (6.9)	5.2-9.2	
30-34	696	58 (8.3)	6.1-11.2	
35-39	487	46 (9.5)	6.6-13.5	
40-44	231	16 (7.2)	4.1-12.2	
45-49	34	3 (10.5)	3.6-26.6	
<b>Marital status</b>				
Never in union	351	40 (11.4)	8.1-15.8	
In union	3,307	256 (7.7)	6.6-9.1	0.1164
No longer in union	398	31 (7.7)	5.1-11.3	
<b>Education level</b>				
No formal education	762	30 (3.9)	2.5-6.0	
Primary	2,607	224 (8.6)	7.2-10.2	0.0003
Secondary+	687	73 (10.7)	8.2-13.8	
<b>Place of residence</b>				
urban	1,128	131 (11.6)	9.3-14.5	
rural	2,928	196 (6.7)	5.6-8.0)	0.0002
<b>Wealth index status</b>				
poorest	966	58 (6.0)	4.3-8.2	
poorer	857	66 (7.7)	5.7-10.4	
middle	771	48 (6.2)	4.5-8.6	0.0002
richer	779	66 (8.4)	6.4-11.0	

Socio-demographic variable	Total n (weighted)	Women took 3 + doses (Weighted)		p-value
		Count (%)	95% CI	
richest	683	89 (13.1)	10.3–16.4	
<b>Occupation</b>				
Unemployed	774	63 (8.1)	6.1–10.8	
Self-employed	2,160	150 (7.0)	5.7–8.5	0.0326
Employed	1,122	114 (10.1)	8.1–12.5	
<b>Geographic zone</b>				
Western	525	11 (2.1)	0.96–4.4	
Northern	384	12 (3.0)	1.6–5.8	
Central	477	51 (10.8)	7.5–15.2	
Southern highlands	215	17 (8.1)	5.6–11.8	
Southern	148	16 (10.6)	6.4–17.1	< 0.0001
South west highlands	400	27 (6.7)	3.9–11.1	
Lake	1,237	101 (8.2)	6.2–10.7	
Eastern	566	86 (15.3)	11.7–19.7	
Zanzibar	104	6 (5.7)	4.2–7.8	

### Distribution of obstetric characteristics and ANC service provider by optimal uptake of IPTp-SP

This study revealed a significant association between optimal uptake of IPTp with parity ( $p = 0.0337$ ), timing of 1st ANC visit ( $p < 0.0001$ ), number of ANC ( $p < 0.0001$ ), and type of health facility that a woman was attending for ANC ( $p = 0.0113$ ). Women with one child and two children (9.3% and 9.8% respectively) received optimal doses as compared to women with three or more children (6.8%). Women who started ANC in the first trimester (12.6%) and attended four or more ANC visits (11.7%) had higher uptake of optimal doses compared to those who started ANC late and attended 1–3 ANC visits. Also, the uptake of optimal doses of IPTp-SP was high for women who attended government health facilities (10.4%) as compared to those who attended non-government facilities (7.4%) during their ANC visits (Table 4).

Table 4  
Distribution of obstetric characteristics and ANC service provider by optimal uptake of IPTp-SP

Obstetric Variable	Total n (weighted)	Women took 3 + doses (weighted)		p-value
		Count (%)	95% CI	
<b>Parity</b>				
1	1,110	103 (9.3)	7.4–11.6	0.0337
2	782	77 (9.8)	7.6–12.7	
3+	2,164	147 (6.8)	5.5–8.4	
<b>Timing of 1st ANC visit</b>				
1st trimester	928	116 (12.6)	10.1–15.5	< 0.0001
2nd trimester	2691	198 (7.3)	6.2–8.7	
3rd trimester	434	13 (2.9)	1.6–5.3	
<b>Number of ANC visits</b>				
1–3	2054	91 (4.4)	3.4–5.6	< 0.0001
4+	1994	233 (11.7)	9.9–13.7	
<b>Health facility for ANC</b>				
Non-government	3199	238 (7.4)	6.3–8.7	0.0113
Government	857	89 (10.4)	8.2–13.3	

### Predictors for the uptake of optimal doses of IPTp-SP during pregnancy

The results of binary logistic regression analysis (crude odds ratios) show that woman's education level, place of residence, employment status, wealth index status, parity, timing of first ANC visit, number of ANC visits and type of ANC facility visited were significant predictors of optimal uptake of IPTp-SP. The women who attained secondary or more education level (COR: 2.9, 95% CI 1.71–5.00), resided at urban (COR: 1.8, 95% CI 1.33–2.53), resided at Eastern zone (COR: 8.6, 95% CI 3.73–19.75), richest (COR: 2.4, 95% CI 1.52–3.66), with low parity (COR: 1.5, 95% CI 1.08–2.09), attended ANC at the first trimester (COR: 4.7, 95% CI 2.55–8.81), attended 4 or more ANC visits (COR: 2.9, 95% CI 2.12–3.86), and attended government health facilities (COR: 1.5, 95% CI 1.09–1.94) had significant higher odds of taking optimal doses of IPTp-SP as recommended by WHO (Table 5). In the multivariable logistic regression, the predictors independently associated with optimal uptake of IPTp-SP were primary (AOR: 2.2, 95% CI 1.26–3.67) and secondary (AOR: 2.1, 95% CI 1.08–4.22) education level, attended ANC at the first trimester (AOR: 2.4, 95% CI 1.20–4.96), attended 4 or more ANC visits (AOR: 1.9, 95% CI 1.34–2.83), and attended government health facilities (AOR: 1.5, 95% CI 1.07–1.97). The findings of geographic zone

show no statistically significant difference in the adjusted odds ratios among women in the western zone with those in the northern and Zanzibar zone (Table 5).

Table 5  
Estimates of Crude Odds ratios (COR) and Adjusted Odds ratios (AOR) for the Optimal Uptake of IPTp

Variables	+COR (95% CI)	p-value	++ AOR (95% CI)	P-Value
<b>Education level</b>				
No formal (ref)	1.0		1.0	
Primary	2.3 (1.42–3.70)	0.001	2.2 (1.26–3.67)	0.005
Secondary+	2.9 (1.71-5.00)	< 0.001	2.1 (1.08–4.22)	0.029
<b>Residence</b>				
Rural (Ref)	1.0		1.0	
urban	1.8 (1.33–2.53)	< 0.001	1.1 (0.66–1.90)	0.677
<b>Occupation</b>				
Unemployed (ref)	1.0			
Self-employed	0.8 (0.58–1.23)	0.383	-	-
Employed	1.3 (0.88–1.84)	0.197		
<b>Wealth index</b>				
Poorest (ref)	1.0		1.0	
Poorer	1.3 (0.84–2.05)	0.227	1.2 (0.78–1.94)	0.364
Middle	1.0 (0.69–1.58)	0.851	0.8 (0.54–1.25)	0.352
Richer	1.4 (0.92–2.27)	0.11	1.0 (0.62–1.75)	0.886
Richest	2.4 (1.52–3.66)	< 0.001	1.3 (0.63–2.52)	0.518
<b>Parity</b>				
1	1.4 (1.00-1.96)	0.051	1.2 (0.80–1.71)	0.412
2	1.5(1.08–2.09)	0.017	1.3 (0.92–1.82)	0.143
3+ (ref)	1.0		1.0	
<b>Timing of 1st ANC visit</b>				
1st trimester	4.7 (2.55–8.81)	< 0.001	2.4 (1.20–4.96)	0.014
2nd trimester	2.6 (1.41–4.85)	0.002	1.8 (0.93–3.47)	0.08
3rd trimester (ref)	1.0		1.0	

**+ COR Stands for Crude Odds Ratios, ++ AOR Stands for Adjusted Odds Ratios**

Variables	<sup>+</sup> COR (95% CI)	p-value	<sup>++</sup> AOR (95% CI)	P-Value
<b>Number of ANC visits</b>				
1–3 (ref)	1.0		1.0	
4+	2.9 (2.12–3.86)	< 0.001	1.9 (1.34–2.83)	< 0.001
<b>Health facility for ANC</b>				
Non-government (ref)	1.0		1.0	
Government	1.5 (1.09–1.94)	0.012	1.5 (1.07–1.97)	0.017
<b>Geographic zone</b>				
Western (ref)	1.0		1.0	
Northern	1.5 (0.53–4.19)	0.443	0.9 (0.32–2.79)	0.911
Central	5.7 (2.40–13.74)	< 0.001	5.0 (2.08–11.95)	< 0.001
Southern highlands	4.2 (1.76–10.15)	0.001	2.8 (1.15–7.02)	0.023
Southern	5.7 (2.19–14.70)	< 0.001	3.8 (1.41–10.13)	0.008
South west highlands	3.4 (1.30–8.87)	0.013	2.7 (1.03–7.29)	0.043
Lake	4.2 (1.84–9.73)	0.001	3.5 (1.51–8.14)	0.004
Eastern	8.6 (3.73–19.75)	< 0.001	4.6 (1.88–11.07)	0.001
Zanzibar	2.9 (1.25–6.71)	0.014	2.1 (0.80–5.36)	0.133
<b><sup>+</sup> COR Stands for Crude Odds Ratios, <sup>++</sup> AOR Stands for Adjusted Odds Ratios</b>				

## Discussion

This study used data from TDHS-MIS 2015/16 to analyze the predictors for the uptake of optimal doses of SP (three or more doses) among pregnant women. The uptake of three or more doses of SP was reported to be 8% countrywide which is still low than the recommended coverage of 80% from WHO and Roll Back Malaria (RBM) benchmark target (3). This was also observed in several studies conducted in other sub-Saharan countries (20–23). Hence, the urgent need to plan effective strategies to improve IPTp-SP coverage and uptake in sub-Saharan Africa.

The predictors for the uptake of optimal doses of SP were; geographical zones, education level (primary, secondary or higher education), attending ANC in the first trimester of pregnancy, attending ANC visit more than four times and attending government health facility for ANC services. Pregnant women who attained at least primary education were likely to receive optimal doses of SP compared to those with informal education. This is because educated pregnant women could be aware and knowledgeable on

the importance and benefits of using SP for malaria prevention during pregnancy. Similarly, the findings from Nigeria (24), Malawi (21, 25), Ghana (22), and Zimbabwe (23) showed that the knowledge on the SP and on the consequences of not taking IPTp-SP as a facilitator toward the uptake hence the association between education level and the likelihood of the uptake of three or more doses of SP for malaria prevention during pregnancy.

Pregnant women who registered and attended ANC clinics in their first trimester received optimal doses of SP compared to those attended ANC clinic in third trimester. The possible explanation could be; attending ANC clinics in first trimester give the room for pregnant women to attend ANC for more than 4 times hence higher chances for start taking SP doses in their second trimester as required. Also, it has been predicted in several studies conducted in Zimbabwe, Sierra Leone, Malawi, Nigeria and Uganda that early booking and attending of first ANC in first or second trimester has an association with receiving optimal doses of SP while late attending to ANC clinic results in lower uptake of SP doses (6, 15, 23, 24, 26).

The significant relationship between number of ANC visit and uptake of optimal doses of SP was observed in our study. The pregnant women who attended at least four ANC visit received optimal doses of SP compared to those with few attendance. The more the pregnant women attend to clinic, the higher the exposure toward health information on IPTp-SP hence the higher likelihood of receiving optimal doses of SP. The findings are consistent with the studies conducted in Malawi, Ghana and Cameroon (21, 27, 28). Also, attending ANC visits only once or at late such as after 36 weeks where SP cannot be administered were observed to be a barrier towards the uptake of optimal doses of SP (25). Therefore, the urge to raise awareness among pregnant women on the importance of early and adequate attendance to ANC clinics so as to receive optimal doses of SP for malaria prevention is important.

Attending government health facilities ANC was found to influence the uptake of optimal SP doses among pregnant women compared to those who attended private clinics. The plausible explanation could be sensitization of the SP uptake under direct observation therapy (DOT) and seriousness on following SP administration protocol. It was noticed that in some private clinics pregnant women were allowed to take the drugs at home hence compromise the optimal uptake of SP doses. The findings are in accordance to a study conducted in Ghana which found poor adherence to DOT in private health facilities as one of the obstacles towards the uptake of optimal doses of SP (29).

Geographical zones were also the predictors for the optimal uptake of SP doses. Being a resident of regions that belong to Central, Eastern, Southern, Lake, Southern highlands, and South west highlands was significantly associated with the optimal uptake of SP doses compared to the residents of Zanzibar and Northern zones. This might be contributed by level of malaria endemicity in different zones. In the zones with a high or moderate level of malaria transmission, possibly the awareness and emphasis on SP uptake could be higher due to higher risk of contracting malaria that's why pregnant women in those zones had higher odds of taking optimal doses of SP compared to those residing at Zanzibar and Northern zones where there is a low level of malaria transmission. The observed findings are in lines with



another study conducted in Tanzania which showed that pregnant women residing in Eastern and Coastal regions had higher odds of optimal uptake of SP (26).

This study had the following limitations; the data analysis was limited only on the variables captured on demographic and health survey questionnaire, some of the important variables that could influence uptake of optimal doses of IPTp-SP were not captured for example socio-cultural factors, knowledge of health care providers and availability of SP in ANC clinics hence hindered full exploration of other important variables. Response (recall) bias was another limitation, the data collection was based on self-reported experiences of the past two years hence due to response bias there was a possibility of over- or underestimation of the responses.

## Conclusions

The uptake of optimal doses of SP among pregnant women in Tanzania is still below the WHO recommendations. The identified predictors for optimal uptake of SP were primary and secondary or higher education level, attending ANC in the first trimester, attending  $\geq 4$  ANC visits, attending a government health facility for ANC services and being a resident of any geographical zone except for Northern and Zanzibar zones. The alarming findings indicate the urgent need to improve the uptake of optimal doses of SP among pregnant women in Tanzania. Therefore, we recommend health education, social and behavior change interventions with the emphasis on the earlier attendance to ANC clinics and on the optimal use of IPTp-SP doses. The mentioned interventions will help to improve the awareness and knowledge of the optimal use of IPTp-SP among pregnant women in Tanzania. Also, private ANC clinics should adhere to the implementation of the DOT policy to improve the uptake of optimal doses of SP among pregnant women who attend private ANC clinics.

## Abbreviations

**ANC** Antenatal Care

**DOT** Direct Observation Therapy

**IPTp-SP** Intermittent Preventive Treatment in Pregnancy with Sulfadoxine-Pyrimethamine

**ITNs** Insecticide Treated Nets

**RBM** Roll Back Malaria

**SP** Sulfadoxine-Pyrimethamine

**TDHS-MIS** Tanzania Demographic and Health survey and Malaria Indicator Survey

**USAID** United States Agency for International Development

## Declarations

### Ethical approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Availability of data and materials

All the data used are available upon request from demographic and health surveys website. The questionnaire used for analysis was women questionnaire which was appended in TDHS-MIS report of 2015/16.

### Competing interests

The authors declare that they have no competing interests.

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### Authors' contributions

VM conceptualized the idea, reviewed the literature, requested the data from USAID, prepared the method section of the manuscript, interpreted the results and prepared the initial draft of the manuscript. CHM prepared the method section of the manuscript, extracted the data, analyzed the data, interpreted the results and prepared the initial draft of the manuscript. AZ prepared the initial draft of the manuscript. TA and FVM critically reviewed the manuscript. All authors read and approved the final version of the manuscript.

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