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ABSTRACT

Significant proportions of pregnant women living in malaria-endemic countries throughout the world are exposed to the risk of malaria. The World Health Organization (WHO) suggests the use of intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) in at least three doses to achieve the optimal benefit of preventing malaria among pregnant women. To examine the uptake of partial and optimal doses, we conducted a secondary data analysis of the 2016 Ghana Malaria Indicator Survey (GMIS) using multivariate analysis. The analysis included a total of 1,220 women age 15-49 who had children under age 24 months and who attended antenatal care (ANC) during their pregnancy.

The results show that, overall, the proportion of women in Ghana with uptake of IPTp-SP during pregnancy was 63% for three or more doses, 27% for one to two doses, and 10% for no dose. Uptake varies by background characteristics. Sociodemographic factors—women's age, wealth status, region, religion, ethnicity—and knowledge-related factors—exposure to messages on treatment of malaria—predicted partial (1-2 doses) or optimal uptake (3+ doses) of IPTp-SP compared to no uptake among pregnant women. Binary regression analysis of uptake of optimal doses of IPTp-SP compared to partial uptake showed significantly higher odds of uptake among women who were exposed to media messages on treatment of malaria.

The Ministry of Health, the National Malaria Control Program, Ghana Health Service, and other stakeholders should take cognizance of these factors in planning programs for improving uptake of IPTp-SP among pregnant women. Efforts should be made by stakeholders to increase women's exposure to mass media messages on the use of IPTp-SP for malaria during pregnancy.

Key words: uptake of intermittent preventive treatment (IPTp-SP); malaria; pregnancy; Ghana, malaria indicator survey (MIS)

1 INTRODUCTION

1.1 Background

About 50 million women living in malaria-endemic countries around the world become pregnant each year (World Health Organization (WHO) 2015a). Of this number, more than 50% live in tropical areas of Africa where there is a high transmission of *Plasmodium falciparum* (WHO 2015a). Countries in sub-Saharan Africa (SSA) continue to suffer disproportionally from the effects of malaria, with pregnant women and children under age 5 being the most vulnerable to malaria infection (Badirou et al. 2018; Owusu-Boateng and Anto 2017; WHO 2017). Estimates show that between 3.1 and 3.5 million cases of clinical malaria, including malaria in pregnancy, are reported in public health facilities each year, with considerable seasonal variations (Fullman et al. 2013; Hemingway 2014; Kayentao et al. 2013; Slutsker and Kachur 2013; West et al. 2013). An estimated 10,000 women and 200,000 infants die as a result of malaria infection during pregnancy, and severe malarial anemia contributes to more than half of these deaths (WHO 2015a).

Malaria is endemic in Ghana, with a population of some 30 million people exposed to malaria infections all year round (United States Agency for International Development (USAID) 2013; WHO 2004). Seasonal variations exist and are more pronounced in the northern part of the country. About 38% of all patients reporting for outpatient services, 36% of all hospital admissions, and 33% of all deaths in children under age 5 reported in Ghana are due to malaria infections (Ghana Health Service (GHS) 2016). Available evidence shows that malaria among pregnant women accounts for about 14% of outpatient cases, 11% of hospital admissions, and 9% of deaths (Boateng et al. 2018; GHS 2016; Odjidja, Kwanin, and Saha 2017). Of the four main types of parasites that cause malaria, *Plasmodium falciparum* accounts for 90-98% of all infections in Ghana, while *Plasmodium malariae* accounts for 2-9%, and *Plasmodium ovale* accounts for 1% (Dako-Gyeke and Kofie 2015; GHS 2016).

In a bid to reduce the burden of malaria in SSA, including Ghana, governments and development partners have deployed several strategies to deal with the problem, especially among pregnant women, neonates, and infants (Mathonga et al. 2012; Snow et al. 2012; WHO 2005). In the 1990s in sub-Saharan countries, malaria prevention during pregnancy was based on a weekly administration of chloroquine prophylaxis during Antenatal Care (ANC) visits (Steketee et al. 2001). As a result of pregnant mothers' poor adherence to treatment outside of the medical environments, and the resistance of the *Plasmodium falciparum* parasite to chloroquine, this strategy became inefficient (Braun et al. 2015; Sirima et al. 2003; Slutsker and Kachur 2013). In 2000, WHO recommended intermittent preventive treatment of malaria in pregnancy using sulfadoxine-pyrimethamine (IPTp-SP) in daily or weekly doses as a new strategy for preventing malaria in pregnancy, to replace chloroquine chemoprophylaxis for pregnant women attending ANC (Yoder et al. 2015; Hill and Kazembe 2006; WHO 2004, 2005).

IPTp-SP use is an integral part of WHO's three-pronged approach to the prevention and treatment of malaria during pregnancy. The package also includes the use of insecticide-treated mosquito Nets (ITNs) as well as effective case management (WHO 2015b; WHO 2014). Until 2012, IPTp-SP consisted of administering two or three doses to pregnant women after the first trimester of pregnancy (WHO 2004, 2005). In 2012, however, after research had shown the safety of IPTp-SP, WHO updated its policy and recommended IPTp-

SP for all pregnant women at each ANC visit from the second trimester till delivery, with doses administered at least one month apart (Kayentao et al. 2013; WHO 2014).

In 2003, based on the WHO recommendation in 2000 concerning use of IPTp-SP, Ghana adopted a new malaria treatment policy, with revisions in 2007 and 2012. The country thus changed from the use of the weekly chloroquine chemoprophylaxis to IPTp-SP as an intervention for malaria prevention during pregnancy (Boateng et al. 2018; GHS 2016). The Reproductive Health Division (RHD) of the Ghana Health Service (GHS), in collaboration with the National Malaria Control Program (NMCP), is charged with the responsibility of implementing IPTp-SP in all public health facilities in Ghana. The NMCP had an objective to reach 100% of pregnant women with IPTp-SP with at least two or more doses by 2015 (Boateng et al. 2018; Dapaa 2017; GHS 2016); however, this goal has not been achieved (Boateng et al. 2018; Nwaefuna et al. 2015).

Despite the clinical effectiveness of IPTp-SP use in pregnancy (Doku, Zankawah, and Adu-Gyamfi 2016; Kayentao et al. 2013; WHO 2014; Yaya et al. 2018), there are demand and supply concerns that affect its administration and use. On the demand side, concerns include attitudes and behaviors of pregnant women shaped by sociocultural factors, which in turn determine how, where, and when pregnant women seek malaria prevention and treatment (Boateng et al. 2018; Dellicour et al. 2010; Dhiman et al. 2012; Pell et al. 2011; Yoder et al. 2015). Other studies have observed that women's limited knowledge of malaria and health during pregnancy, as well as other factors including household decision-making, gender relations, cost, distance from health facilities, access to malaria interventions, and lack of health care infrastructure, limit the uptake of IPTp-SP among pregnant women (Pell et al. 2011). Research has documented associations between having a good knowledge and understanding of malaria in pregnancy and uptake of IPTp-SP (Ibrahim et al. 2017). Also, women's regular attendance at ANC (at least four visits) has been shown to increase the optimal uptake of IPTp-SP (Odjidja, Kwanin, and Saha 2017). A study in Tanzania reported that a majority of respondents linked low compliance with IPTp-SP to a perceived association with some side effects (Mubyazi et al. 2005). Hill et al. (2013) also showed that IPTp-SP uptake among pregnant women was affected by their number and timing of ANC visits, parity, education, knowledge on malaria and IPTp-SP, socioeconomic status, and use of ITNs.

On the supply side, concerns include the lack of familiarity of health providers with IPTp-SP (Lassi et al. 2014; Mubyazi and Bloch 2014; Pell et al. 2014); provider-client interactions (Boateng et al. 2018; McKenzie et al. 2011); periodic shortage of drugs (Akinleye, Falade, and Ajayi 2009); and nonadherence to policy guidelines by health care providers. Additionally, concerns about the safety of SP and poor understanding of the protocol among health care providers have been associated with uptake of IPTp-SP (Hill et al. 2013; Plan 2014; Yoder et al. 2015).

Numerous studies using health-facility data have examined different aspects of IPTp-SP uptake among pregnant women in Ghana (Boateng et al. 2018; Dako-Gyeke and Kofie 2015; Doku, Zankawah, and Adu-Gyamfi 2016; Ibrahim et al. 2017; Nwaefuna et al. 2015; Odjidja, Kwanin, and Saha 2017; Owusu-Boateng and Anto 2017), but only a few have used nationally representative data (Yaya et al. 2018).

Despite efforts including the introduction of National Health Insurance Scheme (NHIS) and the use of mass media campaigns, Ghana is currently below the WHO goal of reaching 80% uptake of optimal doses of IPTp-SP among pregnant women. The NHIS was introduced in 2003 by the government to replace a funding

regime that was dubbed 'cash & carry' (Ministry of Health (MoH), 2008). The NHIS is a pro-poor program that draws resources from various sources, including taxes, insurance premiums, investment returns, and state subsidies (Kumi-Kyereme, Amu, and Darteh 2017). Available statistics show that around 95% of health care services in Ghana, including maternity services, are covered by the scheme (Wang, Temsah, and Mallick 2017). Research shows that 94% of the women under the scheme frequently attend ANC clinics, as opposed to other expectant mothers who are not insured under the scheme. Similarly, 30% of women under the scheme had three or more ANC visits compared with 18% among other women (Mensah, Oppong, and Schmidt 2010). This suggests that women enrolled on the NHIS are more likely to comply with the WHO recommendation of at least four ANC visits.

This paper contributes to the programmatic efforts at dealing with the demand concerns by assessing the determinants of receiving one to two doses on the one hand, and three or more doses on the other hand, and further examines the predictors underlining the observed situation, using nationally representative data from Ghana. Our study provides focus and depth by examining the sociodemographic and knowledge-related factors that influence uptake of IPTp-SP among pregnant women in Ghana.

1.2 Research Objectives

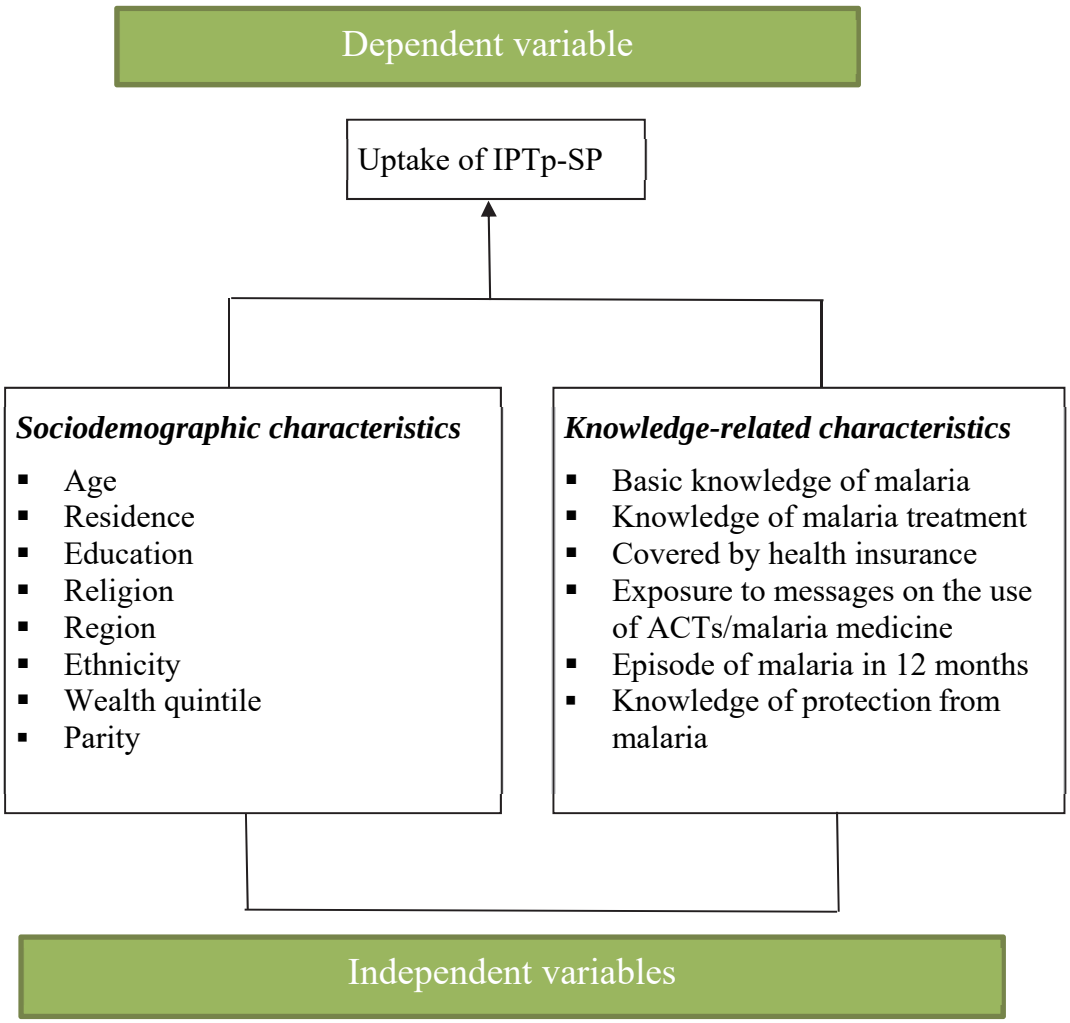
The main objective of this study is to examine the factors that predict the uptake of IPTp-SP among pregnant women in Ghana. Specifically, the study aims to:

- Examine the prevalence of uptake of IPTp-SP in pregnancy.
- Assess the predictors of uptake of one to two doses and three or more doses of IPTp-SP in pregnancy.
- Assess the factors that determine the uptake of partial and optimal doses of IPTp-SP in pregnancy.

1.3 Conceptual Framework

The conceptual framework for the study outlines the dependent and independent variables. The dependent variables include sociodemographic and knowledge-related factors that determine the uptake of IPTp-SP among pregnant women in Ghana. Figure 1 shows the conceptual framework that includes key variables of interest. The eight sociodemographic characteristics include age, residence, education, religion, region, ethnicity, parity, and wealth quintile. The knowledge-related characteristics include basic knowledge of malaria, knowledge of protection from malaria, having malaria in the last 12 months, coverage by health insurance, and exposure to media message on the use of artemisinin-based combination therapies (ACTs)/malaria medicine.

Figure 1 Conceptual framework



2 DATA AND METHODS

2.1 Data

The study uses data from the Ghana Malaria Indicator Survey (GMIS) conducted in 2016. The GMIS relied on the 2010 Ghana Population and Housing Census (PHC) as its sampling frame. The sampling was done in two stages, with each region being stratified into urban and rural areas, making 20 sampling strata.

In the first stage, 200 enumeration areas (EAs)—93 in urban and 107 in rural areas—were selected with probability proportional to EA size and with independent selection in each sampling layer. In the second stage of selection, 30 households were selected from each cluster to make up a total sample size of 6,000 households. Nonresponding households were not replaced (Ghana Statistical Service (GSS), Ghana Health Services (GHS), and ICF 2017). Because of the nonproportional distribution of the sample in the different regions and the possible differences in response rates, sampling weights are required for each analysis using the GMIS 2016 data. This ensures real representation of the results of the survey at the national and regional levels. A total of 5,186 eligible women were identified for an individual interview and 5,150 were interviewed successfully, with a response rate of 99% (GSS, GHS, and ICF 2017).

Our study, which examines factors associated with IPTp-SP use among pregnant women, used data from a total of 1,220 women age 15-49 who had children under age 24 months and had either received no doses of IPTp-SP, received partial doses (one or two), or received optimal doses (three or more) during their pregnancy.

The Ghana Health Ethics Review Board and the ICF Institution Assessment Committee approved the GMIS 2016 protocol. All data and other information gathered were confidential. The dataset is available to the public at https://dhsprogram.com/data/available-datasets.cfm.

2.2 Variables

2.2.1 Dependent variable

The outcome variable used for this study is use of IPTp-SP during pregnancy. The variable was constructed using two MIS survey questions: *During this pregnancy, did you take SP/Fansidar to prevent you from getting malaria, and how many times have you received SP/Fansidar during this pregnancy?* The response for the binary logistic regression was categorized into 1-2 times=0, and 3+ times=1. The multinomial logistic regression was categorized into: no IPT=0; partial (1-2 times)=1; and optimal (3+ times)=2.

2.2.2 Independent variables

The explanatory variables consist of: residence, age, wealth status, education, region, religion, occupation, and parity. Residence was categorized as urban and rural. Age was grouped in 5-year intervals: 15–19, 20–24, 25–29, 30–34, 35–39, 40+. Wealth status was derived from an index of ownership of a variety of household assets and categorized as quintiles: least, second, middle, fourth, and highest. Level of education was captured as: no education, primary, junior secondary/middle, secondary and higher education. Religion was in five categories: Catholic, Protestants, Pentecostals/Charismatic, Islam, and Other. Ethnicities were:

Akan, Ga/Dangme, Ewe, Northern group (this is made up of the Guan, Mole-Dagbani, Grusi, Gurma and Mande people) and Others.

Other explanatory variables included: basic knowledge of malaria; experienced episode of malaria in last 12 months; knowledge of protection from malaria; covered by health insurance; and exposure to media messages on the use of ACTs/malaria medicine.

2.3 Data Analysis

Descriptive and inferential statistics were used. Binary and multinomial logistic regression models were used to assess the determinants of IPTp-SP among pregnant women. A binary logistic regression model was used to estimate the determinants of the uptake of three or more doses of IPTp-SP compared to one to two doses. For this regression, women who had no doses of IPTp-SP were excluded. A multinomial logistic regression was used to assess the determinants of partial and optimal doses of IPTp-SP compared to women with no doses among pregnant women. All frequency distributions were weighted, while the survey command in STATA was used to adjust for the complex sampling structure of the data in the regression analyses. The binary logistic regression results are presented as adjusted odds ratios (ORs) with 95% confidence intervals (CIs); the results of the multinomial regressions are presented as adjusted relative risk ratios with 95% confidence intervals.

3 RESULTS

3.1 Characteristics of Respondents

A total of 1,220 women age 15-49 who had children under age 24 months and had sought ANC during their pregnancy was used for this analysis. The mean age of the women was 29 years. As Table 1 shows, about one-fifth (19%) of the women were from the Ashanti Region, with another 17% from the Greater Accra Region. Over half (58%) had a Junior High School or higher level of education. Half (50%) were Akans, with 31% belonging to the Northern group. Most of the women were Christians, while about one-fifth (21%) professed Islam. The women were distributed fairly evenly across the wealth quintiles, at about 21% each in the lowest, second, and middle quintiles, and 19% each in the fourth and highest quintiles. More than one-third (35%) of the women had given birth to four children.

About one in four women (27%) had been exposed to media messages in the 6 months before the survey on treatment of malaria. About two-thirds (67%) had health insurance coverage, while less than a third (27%) had experienced an episode of malaria in the last 12 months. Nearly half (46%) had basic knowledge of malaria, and over three-fourths (81%) knew how to protect against malaria (see Table 1).

Table 1 Background characteristics of respondents

Percentage of women age 15-49 who had children under age 24 months and had sought ANC during their pregnancy by selected background characteristics, Ghana Malaria Indicator Survey (GMIS) 2016

Variables	Number of respondents (n)	Percent (%)
Demographic characteristics		
Age of respondents		
15-19	85	7.0
20-24	272	22.3
25-29	295	24.2
30-34	307	25.2
35-39	188	15.4
40+	73	6.0
Region		
Western	100	8.2
Central	130	10.7
Greater Accra	206	16.9
Volta	105	8.6
Eastern	99	8.1
Ashanti	231	18.9
Brong Ahafo	111	9.1
Northern	163	13.4
Upper East	45	3.7
Upper West	29	2.4
Level of Education		
No education	271	22.2
Primary	238	19.5
JHS/JSS/Middle	453	37.1
Secondary/SSS/SHS or higher	259	21.2
Ethnicity		
Akan	605	49.6
Ga/Dangme	63	5.2
Ewe	138	11.3
Northern group	378	31.0
Other	36	3.0

Continued...

Table 1—*Continued*

Variables	Number of respondents (n)	Percent (%)
Religion		
Catholic	104	8.5
Protestants	135	11.1
Pentecostals/Charismatic	674	55.2
Islam	258	21.1
Others	49	4.0
Wealth index		
Lowest	250	20.5
Second	253	20.7
Middle	254	20.8
Fourth	236	19.3
Highest	227	18.6
Parity		
1	304	24.9
2	276	22.6
3	209	17.1
4	430	35.2
Exposure to messages on treatment of malaria		
No	891	73.0
Yes	330	27.0
Covered by health insurance		
No	401	32.9
Yes	820	67.1
Experienced episode of malaria in last 12 months		
No	866	71.0
Yes	355	29.1
Total		
Basic knowledge of malaria		
No	661	54.2
Yes	559	45.8
Total		
Knowledge of protection from malaria		
No	229	18.8
Yes	991	81.2
Total	1,220	100

Source: Computed using data from the 2016 Ghana Malaria Indicator Survey.

3.2 Uptake of IPTp-SP

Table 2 reports the percentage of women with a live birth in the 2 years preceding the survey who had an antenatal care visit and received no dose of IPTp-SP, one to two doses, or three or more doses, by their background characteristics. The overall uptake of IPTp-SP for the women was 10% for no dose, 27% for one or two doses, and 63% for three or more doses.

There was a statistically significant association between women's level of education and the uptake of multiple doses IPTp-SP, and also a statistically significant association between religion and IPTp-SP. Almost three-fourths (71%) of women with secondary or higher education received three or more doses compared with 60% of women with no education. Other factors significantly associated with the higher uptake of doses of IPTp-SP were basic knowledge of malaria and health insurance coverage (see Table 2).

Table 2 Bivariate analysis of uptake of IPTs by pregnant women

Percentage of women age 15-49 who had children under age 24 months and had sought ANC during their pregnancy who received no dose of IPTp; at least one IPTp dose and who received 2 doses and 3+ doses, with Chi² p-values.

Variables	Total	0 dose	1-2 doses	3+ doses	p-value
Overall uptake	1,220	10.2	27.0	62.8	-
Age of respondents					0.355
15-19	85	11.8	24.7	63.5	
20-24	272	14.8	29.7	55.5	
25-29	295	7.1	29.6	63.3	
30-34	307	9.4	23.9	66.7	
35-39	188	7.8	26.1	66.1	
40+	73	13.5	24.7	61.8	
Place of residence					0.361
Urban	566	8.3	26.5	65.2	
Rural	654	11.9	27.4	60.7	
Region					0.306
Western	100	10.4	40.6	49.1	
Central	130	6.6	34.5	58.7	
Greater Accra	206	12.1	30.0	57.9	
Volta	105	12.4	19.1	68.5	
Eastern	99	5.8	22.9	71.3	
Ashanti	231	12.0	25.1	62.8	
Brong Ahafo	111	8.1	23.2	68.7	
Northern	163	12.9	23.1	64.0	
Upper East	45	3.5	17.6	78.8	
Upper West	29	9.1	32.4	58.5	
Level of Education					0.005
No education	271	14.5	25.8	59.6	
Primary	238	14.9	26.5	58.6	
JHS/JSS/Middle	453	5.5	32.6	61.9	
Secondary/SSS/SHS or higher	259	9.6	18.9	71.4	
Ethnicity					0.819
Akan	605	9.4	27.8	62.8	
Ga/Dangme	62	13.3	27.0	59.6	
Ewe	138	6.7	30.0	63.3	
Northern group	378	11.9	25.7	62.3	
Other	36	13.5	15.6	70.9	
Religion					0.021
Catholic	104	11.3	22.2	66.5	
Protestants	135	11.3	21.8	66.9	
Pentecostals/Charismatic	674	7.5	30.3	62.2	
Islam	258	15.0	19.9	65.1	
Others	49	16.7	43.5	39.7	
Wealth index					0.080
Lowest	250	11.2	31.5	57.4	
Second	253	11.7	30.4	57.9	
Middle	254	11.8	30.7	57.5	
Fourth	236	9.5	16.8	73.7	
Highest	227	6.5	24.6	68.9	
Parity					0.126
1	304	12.4	25.2	62.3	
2	276	6.6	32.8	60.6	
3	209	24.7	17.6	70.5	
4	431	10.2	29.0	60.8	
Exposure to messages on treatment of malaria					0.069
No	891	11.5	28.0	60.4	
Yes	330	6.7	24.2	69.1	
Covered by health insurance					0.005
No	401	15.3	27.4	57.3	
Yes	820	7.7	26.8	65.5	
Knowledge of malaria treatment					0.647
No	67	13.4	23.1	63.5	
Yes	1,153	10.0	27.2	62.7	
Experienced episode of malaria in last 12 months			.		0.945
No	866	10.1	26.7	63.2	
Yes	355	10.5	27.6	61.9	

Continued...

Table 2—*Continued*

Variables	Total	0 dose	1-2 doses	3+ doses	p-value
Basic knowledge of malaria					0.015
No	661	11.0	31.1	57.9	
Yes	559	9.3	22.1	68.5	
Knowledge of protection from malaria					0.124
No	229	10.1	34.4	55.5	
Yes	991	10.2	25.3	64.5	

**p<0.001; *p<0.05

Source: Computed using data from the 2016 Ghana Malaria Indicator Survey.

3.3 Results of Multinomial Logistic Regression Analysis

Table 3 presents results of multinomial logistic analysis of the factors that determine the uptake of partial (1-2 doses) and optimal (3+ doses) uptake of IPTp-SP compared to women who received no doses. Women's age was a significant predictor of partial uptake of IPTp-SP. Women age 25-29, 30-34, 35-39 and age 40 or older compared with women age 15-19 had a higher relative risk of receiving a partial dose of IPTp-SP compared to no doses. There was a statistically significant association between region and partial uptake of IPTp-SP. Women from the Greater Accra Region, Volta Region, and Ashanti Region compared to those from the Western region had lower relative risk of partial uptake of IPTp-SP compared to no doses. Women from the Northern Region compared with women from Western Region, on the other hand, had a higher relative risk of optimal uptake of IPTp-SP compared to no doses. There was a significant association between religion and uptake of partial doses of IPTp-SP. Pentecostals/charismatics compared with Protestants had a higher relative risk of receiving partial doses of IPTp-SP compared to no doses.

A statistically significant association was observed between ethnicity of women and uptake of both partial and optimal doses of IPTp-SP. Women who belonged to the Northern group compared with Akans had more than two times higher relative risk of using a partial dose of IPTp-SP compared to no doses. Our analysis showed a statistically significant association between wealth status and uptake of optimal doses of IPTp-SP. Women in the fourth wealth quintile compared with women in the lowest wealth quintile had a higher relative risk of receiving optimal doses of IPTp-SP compared to no doses. We observed a statistically significant association between exposure to messages on treatment of malaria and the uptake of optimal doses of IPTp-SP (see Table 3).

Table 3 Multinomial logistic regression models of determinants of uptake of IPTs

Adjusted relative risk ratios (RRR) results on the demographic and health-related factors associated with uptake of partial (1-2 doses) and optimal (3+ doses) of IPTs compared to no doses among pregnant women

	Partial versus none		Optimal versus none	
Variables	RRR	95% CI	RRR	95% CI
Age of respondents				
15-19	Ref			
20-24	1.847	0.65-5.26	1.16	0.44-3.05
25-29	2.886*	1.11-7.50	1.73	0.68-4.44
30-34	3.523*	1.22-10.12	2.54*	1.02-6.33
35-39	3.713*	1.31-10.50	2.65	0.99-7.09
40+	3.554*	1.02-12.34	2.93	0.89-9.63
Region				
Western	Ref			
Central	0.867	0.46-1.63	1.1	0.55-2.22
Greater Accra	0.348*	0.12-1.00	0.23	0.07-0.73
Volta	0.293*	0.09-0.91	0.87	0.30-2.49
Eastern	0.867	0.37-2.02	1.98	0.96-4.06
Ashanti	0.359*	0.17-0.77	0.49	0.16-1.49
Brong Ahafo	0.647	0.27-1.54	1.64	0.72-3.72
Northern	0.546	0.17-1.74	1.18*	0.45-3.04
Upper East	1.567	0.55-4.47	5.30	1.90-14.7
Upper West	0.746	0.24-2.35	1.48	0.56-3.90
Place of residence				
Rural	Ref			
Urban	0.781	0.49-1.23	0.70	0.39-1.24
Level of education				
No education	Ref			
Primary	0.94	0.47-1.89	1.03	0.59-1.77
JSS/JHS/Middle	1.57	0.86-2.88	1.24	0.71-2.61
SSS/SHS/Secondary or higher	0.79	0.37-1.66	1.01	0.52-1.99
Religion				
Protestants	Ref			
Catholic	1.58	0.57-4.38	1.47	0.55-3.94
Pentecostals/Charismatic	2.34*	1.13-4.85	1.71	0.90-3.26
Islam	0.78	0.41-1.46	0.98	0.56-3.75
Others	1.72	0.64-4.58	0.89	0.30-2.68
Ethnicity				
Akan	Ref			
Ga/Dangme	0.58	0.21-1.63	0.67	0.25-1.80
Ewe	1.32	0.43-4.02	1.45	0.56-3.75
Northern groups	2.46*	1.08-5.59	1.87	0.92-3.77
Others	0.70	0.18-2.77	0.83	0.24-2.92
Wealth index				
Lowest	Ref			
Second	0.70	0.39-1.22	0.81	0.44-1.49
Middle	1.03	0.56-1.90	1.19	0.61-2.29
Fourth	1.38	0.47-4.08	2.66**	1.08-6.56
Highest	1.60	0.50-5.11	2.17	0.85-5.58
Parity				
1	Ref			
2	1.22	0.61-2.42	1.19	0.61-2.34
3	0.65	034-1.24	1.02	0.58-1.77
4	0.81	0.37-1.75	0.83	0.39-1.77
Covered by health insurance				
No	Ref			
Yes	1.11	069-1.84	1.39	0.86-2.24
Exposure to messages on treatment of malaria				
No	Ref			
Yes	1.16	0.74-1.83	1.76**	1.15-2.69
Experienced episode of malaria in last 12 months				
No	Ref			
Yes	1.12	0.69-1.84	2.40	0.9-6.7
Knowledge of protection from malaria				
No	Ref			
Yes	0.88	0.55-1.40	0.99	0.64-1.54
Basic knowledge of malaria				
No	Ref			
Yes	0.99	0.64-1.52	0.99	0.64-1.54

**p<0.001; *p<0.05

Source: Computed using data from the 2016 Ghana Malaria Indicator Survey.

3.4 Results of Binary Logistic Regression Analysis

Table 4 presents results of a binary logistic regression analysis of factors that determine the uptake of three or more doses of IPTp-SP among pregnant women compared to taking one to two doses. This regression excludes women who did not take any doses of IPTp-SP. Region was found to have a statistically significant association with uptake of three or more doses of IPTp-SP. For instance, women in the Volta Region had more than three times the odds of uptake of three or more doses of IPTp-SP compared with those from the Western Region. Women in the Eastern, Brong Ahafo, Northern, and Upper East regions compared to the Western region were at higher odds of uptake of three or more doses of IPTp-SP. A statistically significant association was found between exposure to messages on treatment of malaria with ACTs and malaria medicine and uptake of three or more doses of IPTp-SP. Women who had been exposed to messages on treatment of malaria had 1.5 higher odds of optimal uptake of IPTp-SP compared to women who did not have exposure to these messages.

Table 4 Logistic regression analysis of factors associated with uptake of optimal doses (3+) of IPTs among pregnant women compared to partial uptake (1-2 doses). This regression excludes women who did not take any doses of IPTp-SP.

Variables	Adjusted Odds Ratio	95% CI
Age of respondents		
15-19	Ref	
20-24	0.63	0.35-1.13
25-29	0.60	0.33-1.07
30-34	0.71	0.39-1.30
35-39	0.72	0.36-1.42
40+	0.81	0.40-1.64
Region		
Western	Ref	
Central	1.28	0.63-2.60
Greater Accra	0.65	0.35-1.23
Volta	3.03**	1.55-5.91
Eastern	2.31*	1.16-4.61
Ashanti	1.35	0.66-2.73
Brong Ahafo	2.48*	1.37-4.47
Northern	2.12*	0.99-4.37
Upper East	3.32*	1.59-6.97
Upper West	1.90	0.91-3.99
Place of residence		
Rural	Ref	
Urban	0.90	0.56-1.43
Level of education		
No education	Ref	
Primary	1.08	0.70-1.67
JSS/JHS/Middle	0.77	0.51-1.17
SSS/SHS/Secondary or higher	1.25	0.73-2.14
Religion		
Protestants	Ref	
Catholic	0.93	0.52-1.66
Pentecostals/Charismatic	0.73	0.47-1.12
Islam	1.27	0.77-2.08
Others	0.52*	0.28-0.97
Ethnicity		
Akan	Ref	
Ga/Dangme	1.15	0.58-2.26
Ewe	1.10	0.58-2.07
Northern groups	0.78	0.49-1.25
Others	1.15	0.49-2.71
Wealth index		
Lowest	Ref	
Second	1.20	0.82-1.70
Middle	1.17	0..71-1.94
Fourth	2.04	1.09-3.82
Highest	1.43	0.70-2.92
Parity		
1	Ref	
2	0.97	0.58-1.64
3	1.52	0.98-2.36
4	1.01	0.64-1.59
Covered by health insurance		
No	Ref	
Yes	1.23	0.93-1.62
Exposure to messages on treatment of malaria		
No	Ref	
Yes	1.52*	1.07-2.16
Experienced episode of malaria in last 12 months		
No	Ref	
Yes	0.85	0.65-1.12
Knowledge of protection from malaria		
No	Ref	
Yes	1.11	0.80-1.54
Basic knowledge of malaria		
No	Ref	
Yes	1.20	0.86-1.68

**p<0.001; *p<0.05
Source: Computed using data from the 2016 Ghana Malaria Indicator Survey.

4 DISCUSSION

The paper examined the sociodemographic and knowledge-related factors that influence the use of IPTp-SP and the uptake of IPTp-SP among pregnant women in Ghana, using data from the 2016 Ghana Malaria Indicator Survey. The results show that, generally, uptake of IPTp-SP among pregnant women was 10%, 27%, and 63% for no dose, one to two doses, and three and more doses respectively. The uptake of the optimal three or more doses of IPTp-SP was higher than observed in other countries including Zimbabwe (60%) (Chikwasha et al. 2014), Tanzania (43%) (Exavery et al. 2014), Kenya (37%), Sierra Leone (31%), Uganda (25%), and Malawi (13%) (Yaya et al. 2018).

Our study observed a statistically significant association between women's level of education and uptake of IPTp-SP. This finding is consistent with earlier studies conducted in Kenya (Gikandi et al. 2008), Malawi (Holtz et al. 2004), and Uganda (Sangaré et al. 2010). Education could afford women the opportunity to appreciate the benefits of using IPTp-SP, and thus be more likely to do so.

Basic knowledge of malaria among women during pregnancy was found to have a significant association with uptake of IPTp-SP. It is intuitive that knowledge of the cause of malaria, its symptoms, and how malaria can be treated could improve women's decision-making on the use of IPTp-SP in pregnancy. This finding is consistent with findings of a systematic review conducted by Hill et al. (2013).

Evidence exists of an association between access to health insurance and improvement in health outcomes, as seen in studies in the United States (Thornton and Rice 2008) and Ghana (Bosomprah et al. 2015; Brugiavini and Pace 2016; Darteh, Acquah, and Darteh 2017). Our bivariate results found a statistically significant association between coverage of health insurance and uptake of IPTp-SP among women. Health insurance coverage provides a safety net that allows women who otherwise could not afford health care to access these services.

The results of the logistic regression showed that region predicted uptake of three or more doses of IPTp-SP among the women in the study. Women in the Volta, Eastern, Brong Ahafo, Northern, and Upper East Regions had higher odds of uptake of three or more doses of IPTp-SP compared with those from the Western Region. The possible explanation for this observation could be the existence of programs and activities targeting the reduction of malaria in pregnancy among women in these regions, due to their high prevalence of malaria.

Studies have observed significant associations between mass media campaigns and uptake of IPTp-SP in pregnancy (Adebayo, Akinyemi, and Cadmus 2015; Chico et al. 2015; Koenker et al. 2014). Our study found a statistically significant association between exposure to messages on treatment of malaria with ACTs and malaria medicine and uptake of three or more doses of IPTp-SP among the women. These women might have been exposed to information on the benefits of IPTp-SP in pregnancy, and thus their uptake of optimal doses.

The results on partial and optimal uptake of IPTp-SP suggest that uptake of IPTp-SP among pregnant women varies with age. For instance, pregnant women age 25–29 and older had a higher likelihood of taking a partial dose of IPTp-SP compared with women age 15–19. This finding is consistent with a study by Chikwasha et al. (2014), which affirmed that women's age significantly predicted the uptake of IPTp-

SP. Older women might have a better culture of health care utilization due to more experience with childbearing, and thus their higher relative risk of uptake of IPTp-SP.

Also, women who were in the fourth household wealth quintile had a higher relative risk of receiving optimal doses of IPTp-SP compared with those in the lowest quintile. This finding is similar to other studies in sub-Saharan Africa (Yaya et al. 2018), including Uganda (Kemble et al. 2006) and Tanzania (Nganda et al. 2004), showing that the wealth index statistically predicted the uptake of IPTp-SP in pregnancy. Although IPTp-SP is offered free at health facilities, the availability of financial resources could enable women to afford some of the indirect costs associated with accessing health services.

There was a significant association between region and partial uptake of IPTp-SP among women from the Greater Accra, Volta, and Ashanti Regions, showing lower relative risk of partial uptake of IPTp-SP compared with women from Western Region. The possible explanation for this finding could be the difference in beliefs, values, and sociocultural conditions in the regions of the country (Darteh, Acquah, and Kumi-Kyereme 2014).

A study conducted by Pell et al. (2011) observed that social and cultural factors influenced uptake of IPTp-SP among pregnant women in sub-Saharan Africa. In Ghana, our results show that women from the Northern Region had a higher relative risk of optimal uptake of IPTp-SP compared with women from the Western Region. This could be a result of sociocultural differences between these regions. It would be important to conduct further studies to understand these regional variations. Our result is consistent with a study in Tanzania by Exavery et al. (2014), which found a significant association between district or zone of residence and uptake of IPTp-SP.

The limitations of our study include the cross-sectional nature of data, hence our inability to establish causality. Other limitations include the absence of data on the number of antenatal visits made by the women, the timing of these visits, and where the service was sought. There could be limitations due to respondent recall bias or desire to provide socially desirable responses. However, the study has some undeniable strengths. These include the large sample size and the representativeness of the sample, which gave sufficient power and enhanced its generalizability to other settings.

5 CONCLUSIONS

The levels for the uptake of optimal doses of IPTp-SP for malaria in pregnancy are fairly high in Ghana. Sociodemographic factors—women's age, wealth status, region, religion, ethnicity—and knowledge-related factors—exposure to messages on treatment of malaria—predicted partial or optimal uptake of IPTp-SP among pregnant women. It is recommended that the MOH, NMCP, GHS and other stakeholders take cognizance of these factors in planning and carrying out programs geared toward improving uptake of IPTp-SP among pregnant women. Stakeholders should work to ensure an improvement in basic knowledge of malaria. In addition, efforts should be made to increase women's exposure to mass media messages on malaria treatment.

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