BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-027946
Article Type:	Research
Date Submitted by the Author:	26-Nov-2018
Complete List of Authors:	Oppong, Felix; Kintampo Health Research Centre Gyaase, Stephaney; Kintampo Health Research Centre Zandoh, Charles; Kintampo Health Research Centre Nettey, Obed Ernest ; Kintampo Health Research Centre Amenga-Etego, Seeba; Kintampo Health Research Centre Anane, Edward; Kintampo Health Research Centre Adda, Robert ; Kintampo Health Research Centre Dosoo, David; Kintampo Health Research Centre Owusu-Agyei, Seth; Kintampo Health Research Centre; University of Health and Allied Sciences, Institute of Health Research Asante, Kwaku; Kintampo Health Research Centre,
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Intermittent Preventive Treatment of Pregnant Women in Kintampo area of Ghana with Sulphadoxine Pyrimethamine (SP): Trends spanning 2011 and 2015

Felix Boakye Oppong [1], Stephaney Gyaase[1], Charles Zandoh[1], Obed Ernest A. Nettey[1], Seeba Amenga-Etego[1], Edward Apraku Anane[1], Robert Adda[1], David Kwame Dosoo[1], Seth Owusu-Agyei[1,2], Kwaku Poku Asante[1]

[1] Kintampo Health Research Centre, Ghana Health Service, Kintampo, Ghana.

[2] Institute of Health Research, University of Health and Allied Sciences, Ho, Ghana.

Correspondence to

Dr. Kwaku Poku Asante;

P. O. Box 200, Kintampo, Ghana.

Tel: +233352097602

Email: kwakupoku.asante@kintampo-hrc.org

Abstract

Objective

In Ghana, Intermittent Preventive Treatment during pregnancy with sulphadoxine-pyrimethamine (IPTp-SP) is recommended for the prevention of malaria-related adverse outcomes for all pregnant women. The aim of this study is to demonstrate the coverage of IPTp-SP use among pregnant women over a period (2011-2015) and the impact of various socio-demographic groups on the uptake of IPTp-SP.

Design

Retrospective analysis using data for all pregnant women in the Kintampo Health and Demographic Surveillance System (KHDSS) area on the uptake of IPTp-SP spanning the period 2011 and 2015.

Setting

Kintampo North Municipality and Kintampo South District located in the geographical centre of Ghana.

Participants

All pregnant women in the Kintampo Health and Demographic Surveillance System (KHDSS) area.

Primary and secondary outcome measures:

The number of doses of IPTp-SP taken by pregnant women were examined. Logistic regression was used to assess the determinant of uptake of the recommended doses IPTp-SP while adjusting for within-subject correlation from women with multiple pregnancies.

Results

The coverage of the recommended doses of IPTp-SP among all pregnant women in the period was 40.6% (N= 4,065), 44.0% (N= 4,570), 45.9% (N= 4,547), 20.9% (N= 4,295), and 32.4% (N= 3,870)

for 2011, 2012, 2013, 2014 and 2015 respectively. In the adjusted model, having secondary education (OR 1.5, 95% CI: 1.25 - 1.75), aged 20 – 29 years (OR 1.5, 95% CI: 1.30 - 1.65), being pregnant for the first time (OR 1.2, 95% CI: 1.05 - 1.27), married (OR 1.2, 95% CI: 1.07 - 1.25) and the least poor (OR 1.5, 95% CI: 1.36 - 1.71) were significantly more likely to take three or more doses of IPTp-SP.

Conclusion

Several socio-demographic characteristics were associated with the uptake of IPTp-SP. These factors should be considered when developing and implementing strategies aimed at improving the uptake of IPTp-SP.

Article Summary

Strengths and limitations of this study

- This study used data from the Kintampo Health and Demographic Surveillance System, by including all identified pregnant women in the study area over a five-year period.
- Also, because the entire population of pregnant women in the study area were included in the study, there is no bias in terms of selection of respondents.
- The study findings can be generalized to the Kintampo Health and Demographic Surveillance System area and not the whole of Ghana.
- Although no pregnant woman refused participation, it is possible that a handful of pregnant women will be missed due to the approach used in identifying pregnant women.
- The study was limited to finding the socio-demographic characteristics associated with IPTp-SP

Keywords: Pregnant women, Coverage, IPTp-SP, socio-demographic characteristics, KHDSS, Kintampo.

Introduction

Sub-Saharan Africa (SSA) is the region that carries the heaviest malaria burden in the world (1). Among pregnant women in the region, malaria is often the cause of mild to severe anaemia and placental parasitaemia (2). Malaria in pregnancy is also associated with low birth weight, as well as increase in the risk of perinatal mortality (2). Likewise, malaria infection during pregnancy is an important cause of spontaneous abortion and preterm delivery in the region (1). Due to the reduction in immunity during pregnancy, pregnant women are usually more vulnerable to malaria infection; it has been reported that they are four-times more likely to get the disease and a doubled-chance of dying as a result of malaria (1). In Ghana, about 28% of all outpatient department (OPD) attendance by pregnant women is from malaria; about 13.7% of hospital admissions among pregnant women is as a results of malaria whiles 9% of maternal deaths is attributed to malaria (1).

Prevention and effective management of malaria during pregnancy helps in reducing the risk of poor outcomes on both mother and baby. For this reason, in the year 2000, the World Health Organization (WHO) recommended that pregnant women in malaria-endemic countries be given Intermittent Preventive Treatment (IPT), by taking sulphadoxine-pyrimethamine (SP) at least twice at scheduled antenatal visits from 16 weeks of gestation or at quickening (1). Use of IPTp-SP among pregnant women has contributed to about 42% reduction in low birth weight, 38% reduction in neonatal death, and 65% reduction in placental malaria (3). However, the benefits of IPTp-SP have been found to be more pronounced when pregnant women take more doses. Taking three or more doses of IPTp-SP during pregnancy have been known to result in higher mean birth weight, fewer low birth weight as well as less placental malaria, compared to taking at most two doses (4). Based on these evidence, revisions were made by WHO in 2012 with recommendation of increasing the frequency of administering IPTp-SP to pregnant women at each antenatal care (ANC) visit until delivery (4). In

2013, the Ghana National Malaria Control Programme (NMCP) revised its policy, recommending at least three doses of IPTp-SP (5) and have since 2014 been implementing it. The Ghana NMCP's strategic plan for 2005-2015 had targeted that by the year 2015, 100% (i.e. all) of pregnant women should be on IPTp-SP, which is now administered from 16 weeks of gestation onwards or at quickening, and follow-up doses are given on monthly basis.

Over the years, the coverage of at least three doses of IPTp –SP in Ghana has been on the increase, from 28% in 2008 to 60% in 2016 (5). Regardless of the relatively high coverage in the uptake of three or more doses of SP by pregnant women in the country, the gap between uptake of only one dose of IPTp-SP and multiple doses remains significant. For instance in 2016, the coverage of one dose of IPTp-SP was 85% compared to the coverage of at least 3 doses of IPTp-SP, 60% (5).

This manuscript reports the coverage of IPTp-SP among pregnant women and factors that are associated with the uptake of at least one dose and three or more doses of IPTp-SP using data collected between 2011 and 2015 as part of the Kintampo Health and Demographic Surveillance System (6). The findings are expected to serve as evidence to guide the NMCP in the design of appropriate policies and strategies that helps increase the use of IPTp-SP and eventually reduce malaria-related adverse outcomes.

Method

Study area and data description

Data from the Kintampo Health and Demographic Surveillance System (KHDSS) was used. The KHDSS is managed by the Kintampo Health Research Centre (KHRC), which routinely collects health data from residents of Kintampo North Municipality and the Kintampo South District of Ghana, which are two contiguous districts located in the Brong Ahafo Region and lie in the geographical centre of the country (6). The total population is about 154,341 and covers an area of

7,162 square kilometers (7). There are two hospitals, five private clinics, 13 health centres, and 43 Community-based Health Planning and Services (CHPS) that provide antenatal care (ANC) and other health care need of the people. KHDSS routinely collects data on several events including pregnancies, births, deaths and migrations, as well as demographic information such as household socio-economic status, education, causes of death, among others (6).

As part of the routine visits by the KHDSS, in 2011, 2012 and 2013, all registered households were visited three times in a year in a cycle that gave rise to a visit in every four months. In 2014 and 2015, six-monthly updated visits were made to all registered households. At each visit, household heads or in the absence, an adult member of the household who was present were asked by trained field workers if any member of their household was pregnant. Subsequently, identified pregnant women were interviewed by our trained field workers on a one-on-one basis without interference from other household members. Pregnancy registration forms which contained closed-ended questions were used to collect data on basic characteristics of respondents, pregnancy history and outcomes, use of antimalarial during pregnancy, treated mosquito net (ITN) use and ANC attendance records. On the use of IPTp-SP, pregnant women were asked whether they took antimalarial (IPTp-SP) at any ANC visit under the supervision of a healthcare attendance. Records on the number of times they received IPTp-SP and the corresponding dates of medication were transcribed from their ANC cards. Also, the pregnant women were asked if they slept under a treated mosquito net the night before the interview, an answer that was used as a proxy for ITN use during pregnancy. All participants who were 18 years and above individually consented. For participants who were below 18 years, parental consent and assent were obtained. Participation was voluntary since individuals had the right to refuse to be part of the study before or during the interview.

Data on the use of IPTp-SP during pregnancy from 2011 to 2015 was our main focus with the main outcome variable being the number of doses of IPTp-SP taken by each pregnant woman and was dichotomized as 1) No dose versus at least one dose, 2) less than three doses versus three or more doses. For the predictor variables, maternal characteristics namely, age, education, use of ITNs, religion, ethnicity, first or subsequent pregnancy, household size, place of residence (rural or urban), marital status and wealth index were used.

Patients and public involvement

Neither pregnant women nor the public were involved in the development of the research question or design of this study. Key stakeholder meeting will be organized to share the findings with the community and Ghana Health Service who are in charge of health care delivery in the country.

Statistical analysis

Cleaned data were analyzed using STATA version 14.0 (Stata-Corp, College Station, TX). An overall wealth index was computed for each pregnant woman using principal component analysis as presented in Asante et al. 2013 (8). The computation of the wealth index was based on the number and type of assets (such as televisions, cars, electricity, toilet facilities, house ownership) available in a pregnant woman's household. Pregnant women were grouped by their wealth indices into wealth quintiles namely, poorest, more poor, poor, less poor, and least poor. Socio-demographic characteristics of the study participants were summarized using frequencies and percentages.

A univariate logistic regression model was considered for each of the predictor variables to study if they are independently associated with IPTp-SP use. Based on results of past studies (9-14), and interest in all the selected socio-demographic characteristics, we included all the predictor variables in a multiple logistic regression model regardless of their statistical significance in the univariate

analysis. Two different analyses were performed. First, factors associated with the use of at least one dose of IPTp-SP were determined, this was followed by assessing the factors that affect the uptake of three or more doses of IPTp-SP among pregnant women. Considering the period under study, 21.3% of the study participants had more than one pregnancy. Hence, the data used for the analysis had repeated observations for participants who had more than one pregnancy between 2011 and 2015. In accounting for the fact that data from the same subject are not independent, Generalized Estimating Equation (GEE) (15) was used to obtain population-averaged estimates, and to address the correlation present in the data. Robust standard errors were obtained to alleviate the bias associated with possible misspecification of the correlation structure. With less than 8% missing data, complete case analysis was conducted by including subjects for whom all the variables involved in the analysis were observed.

Results

Characteristics of the study population

A total of 17,484 pregnant women were identified from 2011 to 2015. This was made up of 4,065 pregnant women in 2011, 4,570 in 2012, 4,547 in 2013, 4,295 in 2014, and 3,870 in 2015. All the identified pregnant women willingly participated in the study. Over the five-year period, 78.68% (13,756/17,484) of the pregnant women contacted had one pregnancy; the remaining 21.32% (3,728/17,484) who had multiple pregnancies were made up of 20.55% (3,593/17,484) with two pregnancies and 0.77% (135/17,484) with three pregnancies. The study population was predominantly rural made up of 68.29% in 2011, 64.81% in 2012, 65.60% in 2013, 66.78% in 2014 and 66.72% in 2015. In 2011, 2012, 2013, 2014, and 2015, 53.11%, 50.61%, 47.57%, 44.75% and 43.02% respectively had no formal education. Also, for each of the years, more than half (51.49%

in 2011, 52.65% in 2012, 54.78% in 2013, 56.34% in 2014 and 54.60% in 2015) of the study participants were not married.

The coverage of ITN use over the five-year period (2011, 2012, 2013, 2014, and 2015) was 54.51%, 65.69%, 77.68%, 80.23%, and 77.83% respectively. The percentage of pregnant women who attended ANC at least once were 86.37%, 87.81%, 89.36%, 87.10%, and 87.80% in 2011, 2012, 2013, 2014 and 2015 respectively. Other characteristics of the study participants are presented in Table 1.

Table 1. Characteristics of study subjects by year of interaction

Variable	Year				
	2011(N=4065)	2012(N=4570)	2013(N=4547)	2014(N=4295)	2015(N=3870)
Age of mother; n (%)					
12-19 years	495(12.18)	558(12.21)	588(12.93)	574(13.36)	503(13.00)
20-29 years	1,869(45.98)	2,136(46.74)	2,248(49.44)	2,023(47.10)	1,708(44.13)
30-39 years	1,402(34.49)	1,576(34.49)	1,469(32.31)	1,426(33.20)	1,372(35.45)
≥40 years	299(7.36)	300(6.56)	242(5.32%)	272(6.33)	287(7.42)
ϕHousehold size; n (%)					
One member	588(14.46)	800(17.51)	887(19.51)	790(18.39)	720(18.60)
Small	1,189(29.25)	1,312(28.71)	1,311(28.83)	1,302(30.31)	1,148(29.66)
Medium	1,648(40.54)	1,782(38.99)	1,700(37.39)	1,614(37.58)	1,437(37.13)
Large	640(15.74)	676(14.79)	649(14.27)	589(13.71)	565(14.60)
ɣEducation; n (%)					
No formal education	2159(53.11)	2313(50.61)	2163(47.57)	1922(44.75)	1665(43.02)
Primary	947(23.30)	1114(24.38)	1165(25.62)	1115(25.96)	1008(26.05)
Middle/JHS	790(19.43)	957(20.94)	971(21.35)	985(22.93)	949(24.52)
Secondary+	169(4.16)	186(4.07)	248(5.45)	273(6.36)	248(6.41)
Religion; n (%)					
Christian	2260(55.60)	2477(54.20)	2479(54.52)	2311(53.81)	2205(56.98)
Muslims	1207(29.69)	1345(29.43)	1309(28.79)	1333(31.04)	1132(29.25)
Traditional	101(2.48)	126(2.76)	113(2.49)	122(2.84)	98(2.53)
No religion	271(6.67)	301(6.59)	298(6.55)	293(6.82)	259(6.69)
Missing data	226(5.56)	321(7.02)	348(7.65)	236(5.49)	176(4.55)
First pregnancy; n (%)	1,032(25.39)	1,138(24.90)	1,142(25.12)	1,085(25.26)	861(22.25)
Use of ITNs; n (%)	2,216(54.51)	3,002(65.69)	3,532(77.68)	3,446(80.23)	3,012(77.83)
ʃEthnicity; n (%)					
Akan	796(19.58)	943(20.63)	920(20.23)	895(20.84)	818(21.14)
Northern Tribes	2356(57.96)	2623(57.40)	2623(57.69)	2486(57.88)	2236(57.78)
Mo	490(12.05)	501(10.96)	525(11.55)	513(11.94)	467(12.07)
Others	316(7.77)	347(7.59)	310(6.82)	310(7.22)	266(6.87)
Missing data	107(2.63)	156(3.41)	169(3.72)	91(2.12)	83(2.14)
Marital status; n (%)					
Married	1,972(48.51)	2,164(47.35)	2,056(45.22)	1,875(43.66)	1,757(45.40)
Not married	2,093(51.49)	2,406(52.65)	2,491(54.78)	2,420(56.34)	2,113(54.60)
Wealth index; n (%)					
Poorest	1040(25.58)	982(21.49)	951(20.91)	660(15.37)	801(20.70)
More poor	947(23.30)	968(21.18)	970(21.33)	826(19.23)	829(21.42)
Poor	901(22.16)	940(20.57)	940(20.67)	820(19.09)	765(19.77)
Less poor	729(17.93)	891(19.5)	895(19.68)	847(19.72)	771(19.92)
Least poor	439(10.8)	776(16.98)	786(17.29)	1131(26.33)	690(17.83)
Missing data	9(0.22)	13(0.28)	5(0.11)	11(0.26)	14(0.36)
Place of residence; n (%)					
Rural	2,776(68.29)	2,962(64.81)	2,983(65.60)	2,868(66.78)	2,582(66.72)
Urban	1,289(31.71)	1,608(35.19)	1,564(34.40)	1,427(33.22)	1,288(33.28)

ϕ small(2-4 people); medium(5-10 people); large(more than 10 people); ɣSecondary+ (secondary school education or higher); JHS (Junior high school); ***ʃ*** Northern tribes (tribes from any of the three Northern regions of Ghana), other (any other ethnic group)

Figure 1. Doses of IPTp-SP taken by pregnant women in the Kintampo North Municipality and Kintampo South District from 2011 to 2015

Factors associated with uptake of at least one dose of IPTp-SP

For the period 2011, 2012, 2013, 2014, and 2015, the coverage of at least one dose of IPTp-SP was 81.9%, 85.4%, 86.9%, 77.5%, and 84.4% respectively (Figure 1). The coverage of at least one dose of IPTp-SP was significantly higher in 2012, 2013 and 2015, compared to 2011, but lower in 2014.

Table 2 presents the factors associated with taken at least one dose of IPTp-SP. Age, household size, education, religion, being pregnant for the first time, ethnicity, marital status and place of residence were independently associated with the use of IPTp-SP. In the adjusted model, participants with middle/junior high school education (OR 1.13, 95% CI: 1.01-1.27, *p*-value=0.047), those from the Mo ethnic group (OR 1.23, 95% CI: 1.06-1.42, *p*-value=0.006) and urban dwellers (OR 1.56, 95% CI: 1.42-1.71, *p*-value<0.001) were more likely to take at least one dose of IPTp-SP compared to those with no formal education, Akans and those who lived in rural areas respectively. Also, the more poor (OR 1.15, 95% CI: 1.03-1.30, *p*-value=0.018), the poor (OR 1.14, 95% CI 1.01-1.29, *p*-value=0.029), and the less poor (OR 1.14, 95% CI: 1.01-1.29, *p*-value=0.036) were more likely to take at least one dose of IPTp-SP compared to the poorest.

Furthermore, Muslims (OR 0.86, 95% CI: 0.78–0.94, *p*-value=0.002) and those who were pregnant for the first time (OR 0.86, 95% CI: 0.77–0.96, *p*-value<0.006), were less likely to take at least one dose of IPT-SP compared to Christians and those who had been pregnant before respectively.

Table 2. Factors associated with use of at least one dose of IPTp-SP

Predictor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age of mother				
12-19 years	1		1	
20-29 years	1.12 (1.01 - 1.25)	0.044	0.99 (0.87 - 1.13)	0.889
30-39 years	1.22 (1.09 - 1.37)	0.001	1.05 (0.90 - 1.22)	0.549
≥40 years	1.11 (0.93 - 1.31)	0.242	0.98 (0.80 - 1.20)	0.856
Household size				
One member	1		1	
Small	0.95 (0.85 - 1.06)	0.35	1.00 (0.89 - 1.12)	0.987
Medium	0.87 (0.78 - 0.97)	0.01	0.98 (0.87 - 1.10)	0.707
Large	0.90 (0.79 - 1.03)	0.12	1.02 (0.89 - 1.18)	0.763
Education				
None	1		1	
Primary	1.06 (0.97 - 1.16)	0.22	1.03 (0.93 - 1.15)	0.519
Middle/JHS	1.18 (1.07 - 1.30)	0.001	1.13 (1.01 - 1.27)	0.047
Secondary+	0.99 (0.84 - 1.16)	0.874	0.87 (0.71 - 1.06)	0.159
Religion				
Christian	1		1	
Muslims	0.89 (0.82 - 0.96)	0.005	0.86 (0.78 - 0.94)	0.002
Traditional	1.02 (0.81 - 1.29)	0.844	1.16 (0.91 - 1.47)	0.225
No religion	0.88 (0.76 - 1.02)	0.091	0.94 (0.81 - 1.10)	0.44
Missing data				
First pregnancy				
No	1		1	
Yes	0.86 (0.79 - 0.93)	<0.001	0.86 (0.77 - 0.96)	0.006
Use of ITNs				
No	1			
Yes	1.02 (0.94 - 1.10)	0.624	1.05 (0.97 - 1.15)	0.246
Ethnicity				
Akan	1		1	
Northern Tribes	0.93 (0.85 - 1.02)	0.128	1.06 (0.95 - 1.20)	0.298
Mo	1.18 (1.03 - 1.35)	0.02	1.23 (1.06 - 1.42)	0.006
Others	0.92 (0.79 - 1.07)	0.295	0.95 (0.80 - 1.13)	0.577
Marital status				
Not Married	1		1	
Married	1.10 (1.02 - 1.18)	0.012	1.05 (0.96 - 1.14)	0.261
Wealth index				
Poorest	1			
More poor	1.05 (0.94 - 1.17)	0.374	1.15 (1.03 -1.30)	0.018
Poor	1.08 (0.96 - 1.21)	0.182	1.14 (1.01 - 1.29)	0.029
Less poor	1.07 (0.96 - 1.20)	0.218	1.14 (1.01 - 1.29)	0.036
Least poor	1.03 (0.92 - 1.16)	0.608	1.11 (0.97 - 1.26)	0.124
Place of residence				
Rural	1		1	
Urban	1.50 (1.39 - 1.63)	<0.001	1.56 (1.42 - 1.71)	<0.001
Year				
2011	1		1	
2012	1.28 (1.14 - 1.43)	<0.001	1.23 (1.09 - 1.39)	0.001
2013	1.48 (1.32 - 1.66)	<0.001	1.43 (1.26 - 1.62)	<0.001
2014	0.77 (0.69 - 0.86)	<0.001	0.74 (0.66 - 0.83)	<0.001
2015	1.21 (1.08 - 1.36)	0.001	1.16 (1.02 - 1.3)	<0.023

Factors associated with uptake of three or more doses of IPTp-SP

The coverage of three or more doses of IPTp-SP was 40.6%, 44.0%, 45.9%, 20.9% and 32.4% in 2011, 2012, 2013, 2014 and 2015 respectively (Figure 1). Compared to 2011, the coverage of three or more doses of IPTp-SP was significantly lower in 2014 and 2015 (Table 3).

All the maternal characteristics under study were independently associated with the use of three or more doses of IPTp-SP (Table 3). However, in the adjusted model, the use of ITNs was not significantly associated with the use of three or more doses of IPTp-SP. Study participants who were between 20-29 years of age (OR 1.47, 95% CI: 1.30-1.65, *p*-value < 0.001), 30-39 years of age (OR 1.55, 95% CI: 1.35-1.78, *p*-value < 0.001) and 40-50 years of age (OR 1.42 95% CI: 1.18-1.70, *p*-value < 0.001) were more likely to take three or more doses of IPTp-SP compared to participants below 20 years of age. Those who had middle/JHS education (OR 1.25, 95% CI: 1.13-1.38, *p*-value < 0.001), secondary or higher education (OR 1.47, 95% CI: 1.25-1.75, *p*-value < 0.001) were more likely to take three or more doses of IPTp-SP compared to those who had no formal education. Also, study participants who were pregnant for the first time (OR 1.16, 95% CI 1.05-1.27, *p*-value=0.002) were more likely to take three or more doses of IPTp-SP compared to those who had been pregnant before. Married participants (OR 1.15, 95% CI: 1.07-1.25, *p*-value < 0.001) were more likely to take three or more doses of IPTp-SP compared to those who were not married. Participants from urban areas (OR 1.72, 95% CI: 1.59-1.85, *p*-value < 0.001) were also more likely to take three or more doses of IPTp-SP compared to those who lived in rural areas. Similarly, compared to the poorest, the poor (OR 1.38, 95% CI: 1.24-1.53, *p*-value < 0.001), less poor (OR 1.42, 95% CI: 1.27-1.58, *p*-value < 0.001), and the least poor (OR 1.53, 95% CI: 1.36-1.71, *p*-value < 0.001) were more likely to take three or more doses of IPTp-SP.

However, participants who lived in medium households, defined as households with 5-10 people (OR 0.79, 95% CI: 0.71-0.87, *p*-value < 0.001) and large households, defined as households with more than 10 people (OR 0.80, 95% CI: 0.71-0.90, *p*-value < 0.001) were less likely to take three or more doses of IPTp-SP compared to those who lived alone. Muslims (OR 0.77, 95% CI: 0.71-0.84, *p*-value < 0.001), Traditional believers (OR 0.80, 95% CI: 0.65-0.98, *p*-value =0.35), and those who did not belong to any religion (OR 0.77, 95% CI: 0.68-0.88, *p*-value < 0.001) were less likely to take three or more doses of IPTp-SP compared to Christians. Also, with regards to participant's ethnicity, participants from the northern tribes (OR 0.85, 95% CI: 0.77-0.93, *p*-value =0.001) and those from the other ethnic groups (OR 0.77, 95% CI: 0.66-0.89, *p*-value < 0.001) were less likely to take three or more doses of IPTp-SP compared to Akans.

Table 3. Factors associated with the uptake of three or more doses of IPTp-SP

Predictor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age of mother				
12-19 years	1		1	
20-29 years	1.49 (1.35 - 1.64)	<0.001	1.47 (1.30 - 1.65)	<0.001
30-39 years	1.46 (1.32 - 1.61)	<0.001	1.55 (1.35 - 1.78)	<0.001
≥40 years	1.15 (0.99 - 1.33)	0.063	1.42 (1.18 - 1.70)	<0.001
Household size				
One member	1		1	
Small	0.92 (0.84 - 1.00)	0.054	0.97 (0.88 - 1.07)	0.607
Medium	0.70 (0.64 - 0.76)	<0.001	0.79 (0.71 - 0.87)	<0.001
Large	0.68 (0.61 - 0.75)	<0.001	0.80 (0.71 - 0.90)	<0.001
Education				
None	1		1	
Primary	1.18 (1.10 - 1.27)	<0.001	1.09 (0.99 - 1.19)	0.067
Middle/JHS	1.53 (1.42 - 1.65)	<0.001	1.25 (1.13 - 1.38)	<0.001
Secondary+	2.23 (1.94 - 2.56)	<0.001	1.47 (1.25 - 1.75)	<0.001
Religion				
Christian	1		1	
Muslims	0.74 (0.69 - 0.80)	<0.001	0.77 (0.71 - 0.84)	<0.001
Traditional	0.59 (0.48 - 0.71)	<0.001	0.80 (0.65 - 0.98)	0.035
No religion	0.64 (0.56 - 0.72)	<0.001	0.77 (0.68 - 0.88)	<0.001
First pregnancy				
No	1		1	
Yes	1.09 (1.01 - 1.16)	0.018	1.16 (1.05 - 1.27)	0.002
Use of ITNs				
No	1		1	
Yes	0.87 (0.81 - 0.92)	<0.001	1.05 (0.97 - 1.13)	0.226
Ethnicity				
Akan	1		1	
Northern Tribes	0.62 (0.57 - 0.67)	<0.001	0.85 (0.77 - 0.93)	0.001
Mo	0.90 (0.81 - 1.01)	0.062	0.97 (0.86 - 1.09)	0.604
Others	0.73 (0.64 - 0.83)	<0.001	0.77 (0.66 - 0.89)	<0.001
Marital status				
Not Married	1		1	
Married	1.09 (1.02 - 1.15)	0.008	1.15 (1.07 - 1.25)	<0.001
Wealth index				
Poorest	1		1	
More poor	0.98 (0.89 - 1.08)	0.667	1.11 (1.00 - 1.23)	0.048
Poor	1.22 (1.11 - 1.34)	<0.001	1.38 (1.24 - 1.53)	<0.001
Less poor	1.31 (1.19 - 1.44)	<0.001	1.42 (1.27 - 1.58)	<0.001
Least poor	1.40 (1.27 - 1.54)	<0.001	1.53 (1.36 - 1.71)	<0.001
Place of residence				
Rural	1		1	
Urban	1.91 (1.80 - 2.04)	<0.001	1.72 (1.59 - 1.85)	<0.001
Year				
2011	1		1	
2012	1.08 (0.99 - 1.18)	0.094	1.04 (0.94 - 1.15)	0.411
2013	1.13 (1.04 - 1.24)	0.007	1.07 (0.97 - 1.18)	0.166
2014	0.37 (0.34 - 0.41)	<0.001	0.32 (0.29 - 0.36)	<0.001
2015	0.63 (0.57 - 0.69)	<0.001	0.58 (0.53 - 0.65)	<0.001

Discussion

The coverage of IPTp-SP, as well as the socio-demographic characteristics associated with the use of at least one dose of IPTp-SP and three or more doses of IPTp-SP was assessed among pregnant women in Kintampo North Municipality and Kintampo South District of Ghana. The target set by Ghana National Malaria Control Program was for all pregnant women to be on IPTp-SP by the year 2015 (16). Although the coverage of at least one dose of IPTp-SP has remained high, the target set by the Ghana National Malaria Control Program was not achieved in Kintampo North Municipality and Kintampo South District of Ghana during the period of study. Also, from 2011 to 2015, there was no increasing trend in the coverage of at least one dose of IPTp-SP in the study area.

Compared to the coverage of at least one dose of IPTp-SP, the coverage of three or more doses of IPTp-SP was lower. The low coverage of the recommended three or more doses of IPTp-SP has also been reported in other parts of the country (17-19). In a study conducted in northern Ghana, Doku, Zankawah, and Adu-Gyamfi (17) estimated the coverage of three doses of IPTp-SP to be 38%. These low coverages call for the implementation of strategies to scale-up the uptake of the recommended three or more doses of IPTp-SP in Ghana. Also, there was no significant increase in the uptake of the recommended three or more doses of IPTp-SP after the implementation of the new policy, which required pregnant women to take at least three doses of IPTp-SP (5). Rather, the coverage of three or more doses of IPTp-SP in 2014 and 2015 was lower compared to the period preceding the implementation of the policy; the reason for this lower coverage in 2014 and 2015 remains unclear.

Several maternal socio-demographic characteristics were found to be associated with the uptake of at least one dose of IPTp-SP. The association between education and the uptake of at least one dose

of IPTp-SP reiterates the significant role of education with regards to the use of health interventions (20). Similar findings from other studies in Ghana (9) and other parts of Africa including Uganda (11) and Kenya (12, 13), in which IPTp-SP users were found to be significantly more educated compared to nonusers. The results of this study are consistent with the findings of a study conducted in Kenya (21), where those with no formal education, poorer women, and those living in rural areas were significantly less likely to take IPTp-SP. With regards to order of pregnancy, as expected, women who have subsequent pregnancies were more likely to take at least one dose of IPTp-SP. This can be due to their knowledge and benefits of IPTp-SP gained from previous pregnancies.

On the uptake of three or more doses of IPTp-SP, the low uptake among teenage participants compared to older participants can be attributed to the low patronage of antenatal care (ANC) among teenagers. Due to the stigma associated with teenage pregnancy in Ghana, pregnant teenagers are less likely to go for ANC compared to older pregnant women (22, 23). Often, teenagers hide their pregnancies and delay in ANC attendance (23) and are therefore not able to take the recommended doses before they deliver. This was the case with unmarried pregnant women – some of them conceal their pregnancies to avoid societal perceptions such as being tagged as fornicators/adulterers among others, and thus leads to delay in attending ANC. The low uptake of the recommended three or more doses of IPTp-SP among unmarried participants compared to married participants can also be due the encouragement that married women receive from their partners on the importance of IPTp-SP, and the need to take the recommended dose. These findings are similar to the results of a study conducted in Tanzania in which age and marital status of pregnant women were associated with the uptake of the recommended doses of IPTp-SP (24). The high uptake of recommended three doses of IPTp-SP among educated participants compared to those with no formal education can also be attributed to how informed women with formal education are about the increased risk of malaria

infection during pregnancy, and are also aware of the complications associated with malaria during pregnancy (20).

One would expect that due to the knowledge gained from past pregnancies on the importance of malaria prevention during pregnancy and the benefits of IPTp-SP, women with history of past pregnancies will take the recommended three or more doses of IPTp-SP. Conversely, participants who were pregnant for the first time were rather more likely to take the recommended three or doses of IPTp-SP. Other studies in Ghana (25), and other parts of Africa, including Nigeria (26) and Cameroon (27) have however reported no association between subsequent pregnancies and uptake of the recommended doses of IPTp-SP. In Ghana, association has been reported between wealth and health, such that people with better socioeconomic status have better health seeking behaviour (28). This might be one of the reasons why pregnant women in the higher wealth quintiles tend to take the recommended three or more doses of IPTp-SP. Similar results have been reported in Senegal (29), where women in richer or middle wealth quintile were more likely to use the recommended doses of IPTp.

By and large, the most vulnerable, namely teenagers, rural dwellers, those with no formal education, poorer women, the unmarried among others, are the class of pregnant women who are less likely to take at least one dose of IPTp-SP and/or the recommended three or more doses of IPTp-SP. Therefore, in our quest to obtain 100% coverage in the uptake of IPTp-SP, strategies should be put in place to particularly target this group of pregnant women.

It should be emphasized that, the use of data from Health and Demographic Surveillance Systems (HDSSs) can be of great importance in informing policy makers of challenges in several health interventions. Particularly, this study used the KHDSS, by including all identified pregnant women in the study area over a five-year period. Unlike the results of cross-sectional studies, the KHDSS

data was used to assess the coverage of IPTp-SP over a five-year period. It is also important to note that, with the use of data from all 156 communities of the KHDSS, the study findings can be generalized to all the KHDSS area and not all of Ghana. Also, because this study used the entire population of pregnant women, there is no bias in terms of selection of respondents. Although no pregnant woman refused participation, it is possible that a handful of pregnant women will be missed due to the approach used in identifying pregnant women. Also, the study was limited to finding the socio-demographic characteristics associated with IPTp-SP use.

Conclusion

The use of at least one dose of IPTp-SP in the Kintampo Health and Demographic Surveillance System (KHDSS) area is generally high. However, use of the recommended three or more doses of IPTp-SP remains low. The study has found that, the most vulnerable pregnant women are less likely to take at least one dose and/or three or more doses of IPTp-SP as recommended. It is therefore important to consider these factors in the design and implementation of policies and strategies aimed at improving malaria prevention among pregnant women.

Data sharing statement:

Data set is not publicly available. Upon request from the corresponding author, details about the statistical code and/or data set can be obtained.

Acknowledgement:

The authors are grateful to the study participants as well as the study community members. We also appreciate the effort of Abukari Mahama, Grace Manu, Francis Agbokey and Francis Dzabeng for their participation in the manuscript discussion meetings.

Author contributions

FBO, KPA, and SO-A conceived the idea and conceptualized the study. CZ, OEAN and EAA designed the study instrument and collected the data. SA-E and RA managed the data. The data analysis and interpretation of results was conducted by FBO, SG, DKD and KP. FBO drafted the manuscript and SG, CZ, OEAN, SA-E, EAA, DKD, RA, SO-A and KPA contributed to the revisions of the manuscript. All authors read and approved the final manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests

None declared

Ethics approval

Ethical approval was granted by the Institutional Ethics Committee of the Kintampo Health Research Centre of Ghana.

References

1. Ghana Health Service (GHS). Malaria in Pregnancy Training Manual for Health Providers.
2. Desai M, ter Kuile FO, Nosten F, et al. Epidemiology and burden of malaria in pregnancy. *The Lancet infectious diseases.* 2007;7(2):93-104.
3. Garner P, Gulmezoglu A, Garner P, Gulmezoglu A. Drugs for preventing malaria in pregnant women. *Cochrane Database Syst Rev*. 2006;4(4).
4. World Health Organization (WHO). WHO policy brief for the implementation of intermittent preventive treatment of malaria in pregnancy using sulfadoxine-pyrimethamine (IPTp-SP). Geneva: World Health Organization. 2013.
5. Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF. Ghana Malaria Indicator Survey 2016. Accra, Ghana, and Rockville, Maryland, USA: GSS, GHS, and ICF. 2017.
6. Owusu-Agyei S, Ernest A. Nettey O, Zandoh C, et al. Demographic patterns and trends in Central Ghana: baseline indicators from the Kintampo Health and Demographic Surveillance System. *Global health action*. 2012;5(1):19033.
7. Kintampo Health Research Centre (KHRC). Kintampo Health Research Centre Annual Report 2016. 2017.

8. Asante KP, Owusu-Agyei S, Cairns M, et al. Placental malaria and the risk of malaria in infants in a high malaria transmission area in Ghana: a prospective cohort study. *The Journal of infectious diseases*. 2013;208(9):1504-1513.
9. Nwaefuna EK, Afoakwah R, Orish VN, et al. Effectiveness of intermittent preventive treatment in pregnancy with sulphadoxine-pyrimethamine against Submicroscopic falciparum malaria in Central Region, Ghana. *Journal of parasitology research*. 2015;2015.
10. Hajira I. Factors Influencing Uptake of Intermittent Preventive Treatment of Malaria in Pregnancy using Sulphadoxine Pyrimethamine in the Sunyani Municipality, Ghana: University of Ghana; 2015.
11. Kiwuwa MS, Mufubenga P. Use of antenatal care, maternity services, intermittent presumptive treatment and insecticide treated bed nets by pregnant women in Luwero district, Uganda. *Malaria Journal*. 2008;7(1):44.
12. Eijla A, Ayisi G, Kuile F. Implementation of IPT with SP for control of malaria in Kisumu, Kenya. *Malar J*. 2002:265-266.
13. Ouma P, Van Eijk A, Hamel M, et al. The effect of health care worker training on the use of intermittent preventive treatment for malaria in pregnancy in rural western Kenya. *Tropical Medicine & International Health*. 2007;12(8):953-961.
14. Marchant T, Nathan R, Jones C, et al. Individual, facility and policy level influences on national coverage estimates for intermittent preventive treatment of malaria in pregnancy in Tanzania. *Malaria Journal*. 2008;7(1):260.
15. Liang K-Y, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrika*. 1986;73(1):13-22.
16. Owusu-Boateng I, Anto F. Intermittent preventive treatment of malaria in pregnancy: a cross-sectional survey to assess uptake of the new sulfadoxine–pyrimethamine five dose policy in Ghana. *Malaria journal*. 2017;16(1):323.
17. Doku DT, Zankawah MM, Adu-Gyamfi AB. Factors influencing dropout rate of intermittent preventive treatment of malaria during pregnancy. *BMC research notes*. 2016;9(1):460.
18. Tutu EO, Lawson B, Browne E. The effectiveness and perception of the use of sulphadoxine-pyrimethamine in intermittent preventive treatment of malaria in pregnancy programme in Offinso District of Ashanti Region, Ghana. *Malaria journal*. 2011;10(1):385.
19. Hommerich L, Von Oertzen C, Bedu-Addo G, et al. Decline of placental malaria in southern Ghana after the implementation of intermittent preventive treatment in pregnancy. *Malaria Journal*. 2007;6(1):144.
20. Hill J, Hoyt J, van Eijk AM, et al. Factors affecting the delivery, access, and use of interventions to prevent malaria in pregnancy in sub-Saharan Africa: a systematic review and meta-analysis. *PLoS medicine*. 2013;10(7):e1001488.
21. Choonara S, Odimegwu CO, Elwange BC. Factors influencing the usage of different types of malaria prevention methods during pregnancy in Kenya. *African health sciences*. 2015;15(2):413-419.
22. Ghana Health Service (GHS). Family Health Division, Annual Report 2016. 2017.
23. Pell C, Meñaca A, Were F, et al. Factors affecting antenatal care attendance: results from qualitative studies in Ghana, Kenya and Malawi. *PloS one*. 2013;8(1):e53747.
24. Kibusi SM, Kimunai E, Hines CS. Predictors for uptake of intermittent preventive treatment of malaria in pregnancy (IPTp) in Tanzania. *BMC public health*. 2015;15(1):540.
25. Ibrahim H, Maya ET, Issah K, et al. Factors influencing uptake of intermittent preventive treatment of malaria in pregnancy using sulphadoxine pyrimethamine in Sunyani Municipality, Ghana. *Pan African Medical Journal*. 2017;28(122).
26. Amoran OE, Ariba AA, Iyaniwura CA. Determinants of intermittent preventive treatment of malaria during pregnancy (IPTp) utilization in a rural town in Western Nigeria. *Reproductive health*. 2012;9(1):12.

27. Takem EN, Achidi EA, Ndumbe PM. Use of intermittent preventive treatment for malaria by pregnant women in Buea, Cameroon. *Acta Tropica*. 2009;112(1):54-58.
28. Danso-Appiah A, Stolk WA, Bosompem KM, et al. Health seeking behaviour and utilization of health facilities for schistosomiasis-related symptoms in Ghana. *PLoS neglected tropical diseases*. 2010;4(11):e867.
29. Mbengue MAS, Bei AK, Mboup A, et al. Factors influencing the use of malaria prevention strategies by women in Senegal: a cross-sectional study. *Malaria journal*. 2017;16(1):470.

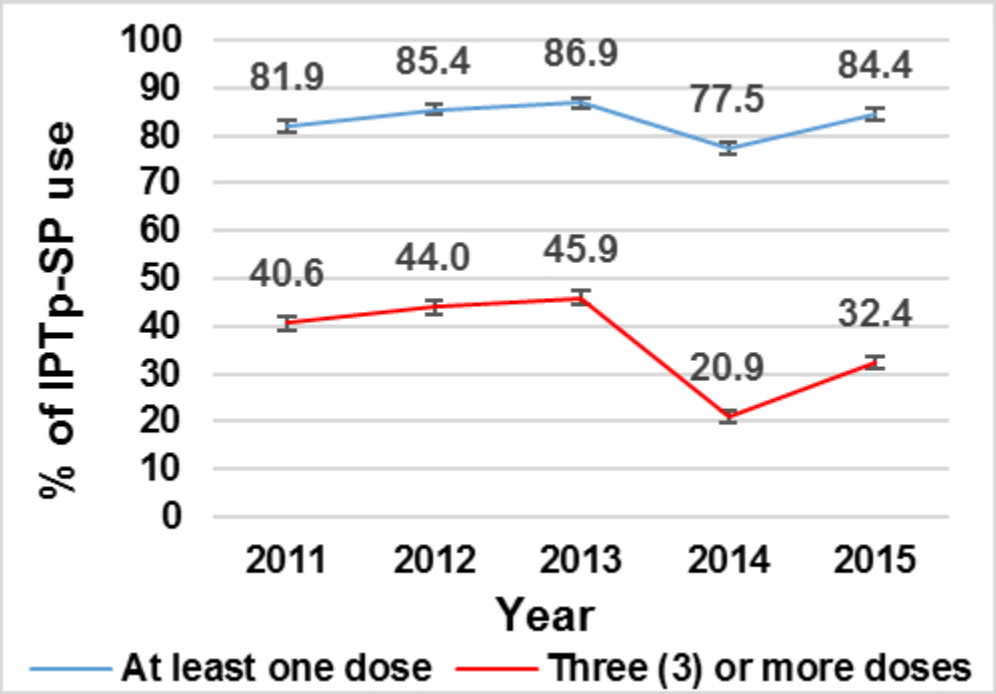

Figure 1. Doses of IPTp-SP taken by pregnant women in the Kintampo North Municipality and Kintampo South District from 2011 to 2015

BMJ Open

Intermittent Preventive Treatment of Pregnant Women in Kintampo area of Ghana with Sulphadoxine Pyrimethamine (SP): Trends spanning 2011 and 2015

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-027946.R1
Article Type:	Research
Date Submitted by the Author:	18-Mar-2019
Complete List of Authors:	Oppong, Felix; Kintampo Health Research Centre Gyaase, Stephaney; Kintampo Health Research Centre Zandoh, Charles; Kintampo Health Research Centre Nettey, Obed Ernest ; Kintampo Health Research Centre Amenga-Etego, Seeba; Kintampo Health Research Centre Anane, Edward; Kintampo Health Research Centre Adda, Robert ; Kintampo Health Research Centre Dosoo, David; Kintampo Health Research Centre Owusu-Agyei, Seth; Kintampo Health Research Centre; University of Health and Allied Sciences, Institute of Health Research Asante, Kwaku; Kintampo Health Research Centre,
Primary Subject Heading:	Infectious diseases
Secondary Subject Heading:	Health policy, Infectious diseases
Keywords:	Pregnant women, Coverage, IPTp-SP, socio-demographic characteristics, KHDSS, Kintampo

Intermittent Preventive Treatment of Pregnant Women in Kintampo area of Ghana with Sulphadoxine Pyrimethamine (SP): Trends spanning 2011 and 2015

Felix Boakye Oppong [1], Stephaney Gyaase[1], Charles Zandoh[1], Obed Ernest A. Nettey[1], Seeba Amenga-Etego[1], Edward Apraku Anane[1], Robert Adda[1], David Kwame Dosoo[1], Seth Owusu-Agyei[1,2], Kwaku Poku Asante[1]

[1] Kintampo Health Research Centre, Ghana Health Service, Kintampo, Ghana.

[2] Institute of Health Research, University of Health and Allied Sciences, Ho, Ghana.

Correspondence to

Dr. Kwaku Poku Asante;

P. O. Box 200, Kintampo, Ghana.

Tel: +233352097602

Email: kwakupoku.asante@kintampo-hrc.org

Abstract

Objective

In Ghana, Intermittent Preventive Treatment during pregnancy with sulphadoxine-pyrimethamine (IPTp-SP) is recommended for the prevention of malaria-related adverse outcomes. This study demonstrates the coverage of IPTp-SP use among pregnant women over a period (2011-2015) and the impact of various socio-demographic groups on the uptake of IPTp-SP.

Design

Retrospective analysis using data from all pregnant women in the Kintampo Health and Demographic Surveillance System area on the uptake of IPTp-SP.

Setting

Kintampo North Municipality and Kintampo South District of Ghana.

Participants

All pregnant women in the Kintampo Health and Demographic Surveillance System area.

Primary and secondary outcome measures:

The number of doses of IPTp-SP taken by pregnant women were examined. Logistic regression was used to assess the determinant of uptake of IPTp-SP while adjusting for within-subject correlation from women with multiple pregnancies.

Results

Data from 2011 to 2015 with a total of 17,484 pregnant women were used. The coverage of the recommended three or more doses of IPTp-SP among all pregnant women was 40.6%, 44.0%, 45.9%, 20.9%, and 32.4% in 2011, 2012, 2013, 2014 and 2015 respectively. In the adjusted analysis, age, household size, education, religion, number of antenatal care visits, ethnicity, marital status, wealth index and place of residence were significantly associated with the uptake of three or more doses of IPTp-SP. Having middle school education or higher, aged 20 years and above, visiting ANC

five times or more (OR 2.83, 95% CI: 2.64-3.03), being married (OR 1.10, 95% CI: 1.02-1.19) and those in higher wealth quintiles were significantly more likely to take three or more doses of IPTp-SP.

Conclusion

The uptake of the recommended three or more doses of IPTp-SP is low in the study area. We recommend a community-based approach to identify women during early pregnancy and to administer IPTp-SP.

Article Summary

Strengths and limitations of this study

- This study used data from the Kintampo Health and Demographic Surveillance System, by including all identified pregnant women in the study area over a five-year period to assess how coverage of IPTp-SP has changed over the past few years.
- Also, because the entire population of pregnant women in the study area were included, there is no bias in terms of selection of respondents.
- The study findings can be generalized to the Kintampo Health and Demographic Surveillance System area and not the whole of Ghana.
- Although no pregnant woman refused participation, it is possible that a handful of pregnant women will be missed due to the approach used in identifying pregnant women.
- The study was limited to finding the maternal characteristics associated with IPTp-SP.

Keywords: Pregnant women, Coverage, IPTp-SP, socio-demographic characteristics, KHDSS, Kintampo.

Introduction

Sub-Saharan Africa (SSA) is the region that carries the heaviest malaria burden in the world (1). Among pregnant women in the region, malaria is often the cause of mild to severe anaemia and placental parasitaemia (2). Malaria in pregnancy is also associated with low birth weight, as well as increase in the risk of perinatal mortality (2). Likewise, malaria infection during pregnancy is an important cause of spontaneous abortion and preterm delivery in the region (1). Due to the decreased immunity during pregnancy, pregnant women are usually more vulnerable to malaria infection; it has been reported that they are four-times more likely to get the disease and have a doubled-chance of dying as a result of malaria (3). In Ghana, about 28% of all outpatient department (OPD) attendance by pregnant women is due to malaria; about 13.7% of hospital admissions among pregnant women is as a results of malaria whiles 9% of maternal deaths is attributed to malaria (1).

Prevention and effective management of malaria during pregnancy helps in reducing the risk of poor outcomes for both mother and baby. For this reason, in the year 2000, the World Health Organization (WHO) recommended that pregnant women in malaria-endemic countries be given Intermittent Preventive Treatment (IPT), by taking sulphadoxine-pyrimethamine (SP) at least twice at scheduled antenatal visits from 16 weeks of gestation or at quickening (1). Use of IPTp-SP among pregnant women has contributed to about 42% reduction in low birth weight, 38% reduction in neonatal death, and 65% reduction in placental malaria (4). However, the benefits of IPTp-SP have been found to be more pronounced when pregnant women take more doses. Taking three or more doses of IPTp-SP during pregnancy has been found to result in higher mean birth weight, fewer low birth weight as well as less placental malaria, compared to taking at most two doses (5). Based on these evidence, revisions were made by WHO in 2012 with recommendation of increasing the frequency of administering IPTp-SP to pregnant women at each antenatal care (ANC) visit until delivery (5). In

2013, the Ghana National Malaria Control Programme (NMCP) revised its policy, recommending at least three doses of IPTp-SP (6) and have since 2014 been implementing it. The Ghana NMCP's strategic plan for 2005-2015 had targeted that by the year 2015, all pregnant women should receive two or more doses of IPTp-SP, which is now administered from 16 weeks of gestation onwards or at quickening, and follow-up doses given on monthly basis.

Over the years, the coverage of at least three doses of IPTp –SP in Ghana has been on the increase, from 28% in 2008 to 60% in 2016 (6). Regardless of the relatively high coverage in the uptake of three or more doses of SP by pregnant women in the country, the gap between uptake of only one dose of IPTp-SP and multiple doses remains significant. For instance in 2016, the coverage of one dose of IPTp-SP was 85% compared to the 60% coverage of at least 3 doses of IPTp-SP (6).

This manuscript reports the coverage of IPTp-SP among pregnant women and factors that are associated with the uptake of at least one dose and three or more doses of IPTp-SP using data collected between 2011 and 2015 as part of the Kintampo Health and Demographic Surveillance System (7). The findings are expected to serve as evidence to guide the NMCP in the design of appropriate policies and strategies that can help increase the use of IPTp-SP and eventually reduce malaria-related adverse outcomes during pregnancy.

Method

Study area and data description

Data from the Kintampo Health and Demographic Surveillance System (KHDSS) was used. The KHDSS which is managed by the Kintampo Health Research Centre (KHRC) routinely collects health data from residents of Kintampo North Municipality and Kintampo South District of Ghana. These are two contiguous districts located in the Brong Ahafo Region and lie in the geographical centre of the country (7). With a total population of about 154,341, it covers an area of 7,162 square

kilometers (8). There are two hospitals, five private clinics, 13 health centres, and 43 Community-based Health Planning and Services (CHPS) that provide antenatal care (ANC) and other health care need of the people. KHDSS routinely collects data on several events including pregnancies, births, deaths and migrations, as well as demographic information such as household socio-economic status, education, causes of death, among others (7).

As part of the routine visits by the KHDSS, in 2011, 2012 and 2013, all registered households were visited three times in a year in a cycle that gave rise to a visit in every four months. In 2014 and 2015, six-monthly updated visits were made to all registered households. At each visit, household heads (or in the absence, an adult member of the household who was present) were asked by trained field workers if any member of their household was pregnant. Subsequently, identified pregnant women were interviewed by our trained field workers on a one-on-one basis without interference from other household members. Pregnancy registration forms which contained closed-ended questions were used to collect data on basic characteristics of respondents, pregnancy history and outcomes, use of antimalarial during pregnancy, treated mosquito net (ITN) use and ANC attendance records. Likewise, after birth, study participants were visited and a birth registration form was used to document birth information and to also collect complete records of the pregnancy data. On the use of IPTp-SP, study participants were asked whether they took antimalarial (IPTp-SP) at any ANC visit under the supervision of a healthcare attendant. Records on the number of times they received IPTp-SP and the corresponding dates of medication were transcribed from their ANC cards. All participants who were 18 years and above individually consented. For participants who were below 18 years, parental consent and assent were obtained. Participation was voluntary since individuals had the right to refuse to be part of the study before or during the interview.

Data on the use of IPTp-SP during pregnancy from 2011 to 2015 was our main focus with the main outcome variable being the number of doses of IPTp-SP taken by each pregnant woman and was dichotomized as 1) No dose versus at least one dose, 2) less than three doses versus three or more doses. For the predictor variables, maternal characteristics namely, age, education, use of ITNs, religion, ethnicity, first or subsequent pregnancy, number of ANC visits, household size, place of residence (rural or urban), marital status and wealth index were used.

Patients and public involvement

The study did not recruit patients. Neither pregnant women nor the public were involved in the development of the research question or design of this study. Key stakeholder meeting will be organized to share the findings with the community and Ghana Health Service who are in charge of health care delivery in the country.

Statistical analysis

Cleaned data were analyzed using STATA version 14.0 (Stata-Corp, College Station, TX). An overall wealth index was computed for each pregnant woman using principal component analysis as presented in Asante et al. 2013 (9). The computation of the wealth index was based on the number and type of assets (such as televisions, cars, electricity, toilet facilities, house ownership) available in a pregnant woman's household. Pregnant women were grouped by their wealth indices into wealth quintiles namely, poorest, more poor, poor, less poor, and least poor. Socio-demographic characteristics of the study participants were summarized using frequencies and percentages.

A univariate logistic regression model was considered for each of the predictor variables to study if they are independently associated with IPTp-SP use. Based on results of past studies (10-15), and interest in all the selected socio-demographic characteristics, we included all the predictor variables

in a multiple logistic regression model regardless of their statistical significance in the univariate analysis. Two different analyses were performed. First, factors associated with the use of at least one dose of IPTp-SP were determined. This was followed by assessing the factors that were associated with the uptake of three or more doses of IPTp-SP. Considering the period under study, 21.3% of the study participants had more than one pregnancy. Hence, the data used for the analysis had repeated observations for participants who had more than one pregnancy between 2011 and 2015. In accounting for the fact that data from the same subject are not independent, Generalized Estimating Equation (GEE) (16) was used to obtain population-averaged estimates, and to address the correlation present in the data. Robust standard errors were obtained to alleviate the bias associated with possible misspecification of the correlation structure. With less than 8% missing data, complete case analysis was conducted by including subjects for whom all the variables involved in the analysis were observed.

Results

Characteristics of the study population

A total of 17,484 pregnant women were identified from 2011 to 2015. This was made up of 4,065 pregnant women in 2011, 4,570 in 2012, 4,547 in 2013, 4,295 in 2014, and 3,870 in 2015. All the identified pregnant women willingly participated in the study. Over the five-year period, 78.68% (13,756/17,484) of the pregnant women contacted had one pregnancy; the remaining 21.32% (3,728/17,484) who had multiple pregnancies were made up of 20.55% (3,593/17,484) with two pregnancies and 0.77% (135/17,484) with three pregnancies. Details of the characteristics of the study participants are presented in Table 1.

Table 1. Characteristics of study subjects by year of interaction

Variable	Year				
	2011(N=4065)	2012(N=4570)	2013(N=4547)	2014(N=4295)	2015(N=3870)
Age of mother					
12-19 years	12.18(495)	12.21(558)	12.93(588)	13.36(574)	13.00(503)
20-29 years	45.98(1,869)	46.74(2,136)	49.44(2,248)	47.10(2,023)	44.13(1,708)
30-39 years	34.49(1,402)	34.49(1,576)	32.31(1,469)	33.20(1,426)	35.45(1,372)
≥40 years	7.36(299)	6.56(300)	5.32(242)	6.33(272)	7.42(287)
[ϕ]Household size					
One member	14.46(588)	17.51(800)	19.51(887)	18.39(790)	18.60(720)
Small	29.25(1,189)	28.71(1,312)	28.83(1,311)	30.31(1,302)	29.66(1,148)
Medium	40.54(1,648)	38.99(1,782)	37.39(1,700)	37.58(1,614)	37.13(1,437)
Large	15.74(640)	14.79(676)	14.27(649)	13.71(589)	14.60(565)
[γ]Education					
No formal education	53.11(2159)	50.61(2313)	47.57(2163)	44.75(1922)	43.02(1665)
Primary	23.30(947)	24.38(1114)	25.62(1165)	25.96(1115)	26.05(1008)
Middle/JHS	19.43(790)	20.94(957)	21.35(971)	22.93(985)	24.52(949)
Secondary+	4.16(169)	4.07(186)	5.45(248)	6.36(273)	6.41(248)
Religion					
Christian	55.60(2260)	54.20(2477)	54.52(2479)	53.81(2311)	56.98(2205)
Muslims	29.69(1207)	29.43(1345)	28.79(1309)	31.04(1333)	29.25(1132)
Traditional	2.48(101)	2.76(126)	2.49(113)	2.84(122)	2.53(98)
No religion	6.67(271)	6.59(301)	6.55(298)	6.82(293)	6.69(259)
Missing data	5.56(226)	7.02(321)	7.65(348)	5.49(236)	4.55(176)
First pregnancy	25.39(1,032)	24.90(1,138)	25.12(1,142)	25.26(1,085)	22.25(861)
Use of ITNs	54.51(2,216)	65.69(3,002)	77.68(3,532)	80.23(3,446)	77.83(3,012)
Number of ANC visits					
0 or 1 visit	6.99(284)	6.39(292)	7.15(325)	6.43(276)	7.05(273)
2 to 4 visits	44.94(1827)	44.73(2044)	44.64(2030)	44.77(1923)	42.95(1662)
5 or more visits	48.07(1954)	48.88(2234)	48.21(2192)	48.80(2096)	50.00(1935)
[ʃ]Ethnicity					
Akan	19.58(796)	20.63(943)	20.23(920)	20.84(895)	21.14(818)
Northern Tribes	57.96(2356)	57.40(2623)	57.69(2623)	57.88(2486)	57.78(2236)
Mo	12.05(490)	10.96(501)	11.55(525)	11.94(513)	12.07(467)
Others	7.77(316)	7.59(347)	6.82(310)	7.22(310)	6.87(266)
Missing data	2.63(107)	3.41(156)	3.72(169)	2.12(91)	2.14(83)
Marital status					
Married	48.51(1,972)	47.35(2,164)	45.22(2,056)	43.66(1,875)	45.40(1,757)
Not married	51.49(2,093)	52.65(2,406)	54.78(2,491)	56.34(2,420)	54.60(2,113)
Wealth index					
Poorest	25.58(1040)	21.49(982)	20.91(951)	15.37(660)	20.70(801)
More poor	23.30(947)	21.18(968)	21.33(970)	19.23(826)	21.42(829)
Poor	22.16(901)	20.57(940)	20.67(940)	19.09(820)	19.77(765)
Less poor	17.93(729)	19.50(891)	19.68(895)	19.72(847)	19.92(771)
Least poor	10.80(439)	16.98(776)	17.29(786)	26.33(1131)	17.83(690)
Missing data	0.22(9)	0.28(13)	0.11(5)	0.26(11)	0.36(14)
Place of residence					
Rural	68.29(2,776)	64.81(2,962)	65.60(2,983)	66.78(2,868)	66.72(2,582)
Urban	31.71(1,289)	35.19(1,608)	34.40(1,564)	33.22(1,427)	33.28(1,288)

Data is presented as percentage (frequency); ϕ small(2-4 people); medium(5-10 people); large(more than 10 people); ɣSecondary+ (secondary school education or higher); JHS (Junior high school); ƒ Northern tribes (tribes from any of the three Northern regions of Ghana), other (any other ethnic group)

Figure 1. Doses of IPTp-SP taken by pregnant women in the Kintampo North Municipality and Kintampo South District from 2011 to 2015

Factors associated with uptake of at least one dose of IPTp-SP

The coverage of at least one dose of IPTp-SP over the five-year period is presented in Figure 1. There were significantly higher coverage of at least one dose of IPTp-SP in 2012, 2013 and 2015, compared to 2011, but lower coverage in 2014 (Table 2).

Table 2 presents the results of the association between all the maternal characteristics under study and the uptake of at least one dose of IPTp-SP. Age of mother, household size, education, religion, being pregnant for the first time, number of ANC visits, ethnicity, marital status and place of residence were independently associated with the use of IPTp-SP. However, in the adjusted analysis, factors that were significantly associated with the uptake of at least one dose of IPTp-SP were religion of participant, order of pregnancy, number of ANC visits, ethnicity and place of residence (Table 2).

Table 2. Factors associated with use of at least one dose of IPTp-SP

Predictor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age of mother				
12-19 years	1		1	
20-29 years	1.12 (1.01 - 1.25)	0.044	1.00 (0.87 - 1.15)	0.999
30-39 years	1.22 (1.09 - 1.37)	0.001	1.06 (0.90 - 1.25)	0.485
≥40 years	1.11 (0.93 - 1.31)	0.242	1.01 (0.81 - 1.24)	0.959
Household size				
One member	1		1	
Small	0.95 (0.85 - 1.06)	0.350	1.00 (0.88 - 1.12)	0.939
Medium	0.87 (0.78 - 0.97)	0.010	0.98 (0.87 - 1.11)	0.795
Large	0.90 (0.79 - 1.03)	0.120	1.03 (0.89 - 1.19)	0.698
Education				
None	1		1	
Primary	1.06 (0.97 - 1.16)	0.220	1.01 (0.91 - 1.13)	0.803
Middle/JHS	1.18 (1.07 - 1.30)	0.001	1.08 (0.95 - 1.22)	0.227
Secondary+	0.99 (0.84 - 1.16)	0.874	0.85 (0.69 - 1.03)	0.101
Religion				
Christian	1		1	
Muslims	0.89 (0.82 - 0.96)	0.005	0.86 (0.78 - 0.95)	0.003
Traditional	1.02 (0.81 - 1.29)	0.844	1.20 (0.93 - 1.53)	0.158
No religion	0.88 (0.76 - 1.02)	0.091	0.98 (0.83 - 1.15)	0.771
First pregnancy				
No	1		1	
Yes	0.86 (0.79 - 0.93)	<0.001	0.84 (0.75 - 0.94)	0.002
Use of ITNs				
No	1			
Yes	1.02 (0.94 - 1.10)	0.624	1.05 (0.96 - 1.15)	0.261
Number of ANC visits				
0 or 1 visit	1			
2 to 4 visits	8.71 (7.71 - 9.82)	<0.001	8.87 (7.80 - 10.08)	<0.001
5 or more visits	5.48 (4.88 - 6.15)	<0.001	5.22 (4.60 - 5.92)	<0.001
Ethnicity				
Akan	1		1	
Northern Tribes	0.93 (0.85 - 1.02)	0.128	1.05 (0.93 - 1.18)	0.475
Mo	1.18 (1.03 - 1.35)	0.020	1.19 (1.03 - 1.39)	0.021
Others	0.92 (0.79 - 1.07)	0.295	0.93 (0.78 - 1.12)	0.456
Marital status				
Not Married	1		1	
Married	1.10 (1.02 - 1.18)	0.012	1.01 (0.92 - 1.11)	0.842
Wealth index				
Poorest	1			
More poor	1.05 (0.94 - 1.17)	0.374	1.11 (0.98 - 1.26)	0.099
Poor	1.08 (0.96 - 1.21)	0.182	1.09 (0.96 - 1.24)	0.171
Less poor	1.07 (0.96 - 1.20)	0.218	1.07 (0.94 - 1.22)	0.299
Least poor	1.03 (0.92 - 1.16)	0.608	1.04 (0.91 - 1.19)	0.566
Place of residence				
Rural	1		1	
Urban	1.50 (1.39 - 1.63)	<0.001	1.56 (1.42 - 1.72)	<0.001
Year				
2011	1		1	
2012	1.28 (1.14 - 1.43)	<0.001	1.24 (1.10 - 1.41)	0.001
2013	1.48 (1.32 - 1.66)	<0.001	1.50 (1.32 - 1.70)	<0.001
2014	0.77 (0.69 - 0.86)	<0.001	0.72 (0.64 - 0.81)	<0.001

2015	1.21 (1.08 - 1.36)	0.001	1.19 (1.05 - 1.36)	0.008

Factors associated with uptake of three or more doses of IPTp-SP

The coverage of the recommended three or more doses of IPTp-SP was 40.6%, 44.0%, 45.9%, 20.9% and 32.4% in 2011, 2012, 2013, 2014 and 2015 respectively (Figure 1). Compared to 2011, the coverage of three or more doses of IPTp-SP was significantly lower in 2014 and 2015. However, for 2012 and 2013, the coverage of three or more doses of IPTp-SP was significantly higher compared to the coverage in 2011 (Table 3).

All the maternal characteristics under study were independently associated with the uptake of the recommended three or more doses of IPTp-SP (Table 3). On the other hand, after adjusting for all other factors, being pregnant for the first time and use of ITNs were not significantly associated with the uptake of three or more doses of IPTp-SP. The detailed results of the factors associated with the uptake of three or more doses of IPTp-SP is presented in Table 3.

Table 3. Factors associated with the uptake of three or more doses of IPTp-SP

Predictor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age of mother				
12-19 years	1		1	
20-29 years	1.49 (1.35 - 1.64)	<0.001	1.28 (1.13 - 1.45)	<0.001
30-39 years	1.46 (1.32 - 1.61)	<0.001	1.35 (1.17 - 1.56)	<0.001
≥40 years	1.15 (0.99 - 1.33)	0.063	1.27 (1.05 - 1.53)	0.013
Household size				
One member	1		1	
Small	0.92 (0.84 - 1.00)	0.054	1.01 (0.91 - 1.12)	0.817
Medium	0.70 (0.64 - 0.76)	<0.001	0.83 (0.75 - 0.91)	<0.001
Large	0.68 (0.61 - 0.75)	<0.001	0.87 (0.77 - 0.99)	0.029
Education				
None	1		1	
Primary	1.18 (1.10 - 1.27)	<0.001	1.05 (0.96 - 1.15)	0.288
Middle/JHS	1.53 (1.42 - 1.65)	<0.001	1.17 (1.05 - 1.29)	0.003
Secondary+	2.23 (1.94 - 2.56)	<0.001	1.31 (1.10 - 1.56)	0.002
Religion				
Christian	1		1	
Muslims	0.74 (0.69 - 0.80)	<0.001	0.83 (0.76 - 0.90)	<0.001
Traditional	0.59 (0.48 - 0.71)	<0.001	0.83 (0.67 – 1.02)	0.082
No religion	0.64 (0.56 - 0.72)	<0.001	0.83 (0.72 - 0.95)	0.007
First pregnancy				
No	1		1	
Yes	1.09 (1.01 - 1.16)	0.018	1.07 (0.97 – 1.18)	0.170
Use of ITNs				
No	1		1	
Yes	0.87 (0.81 - 0.92)	<0.001	1.07 (0.99 - 1.16)	0.076
Number of ANC visits				
0 or 1 visit	-		-	
2 to 4 visits	1		1	
5 or more visits	3.04 (2.85 - 3.23)	<0.001	2.83 (2.64 - 3.03)	<0.001
Ethnicity				
Akan	1		1	
Northern Tribes	0.62 (0.57 - 0.67)	<0.001	0.87 (0.79 - 0.97)	0.010
Mo	0.90 (0.81 - 1.01)	0.062	0.97 (0.86 - 1.10)	0.646
Others	0.73 (0.64 - 0.83)	<0.001	0.77 (0.66 - 0.90)	0.001
Marital status				
Not Married	1		1	
Married	1.09 (1.02 - 1.15)	0.008	1.10 (1.02 - 1.19)	0.015
Wealth index				
Poorest	1		1	
More poor	0.98 (0.89 - 1.08)	0.667	1.03 (0.93 - 1.15)	0.526
Poor	1.22 (1.11 - 1.34)	<0.001	1.28 (1.15 - 1.43)	<0.001
Less poor	1.31 (1.19 - 1.44)	<0.001	1.25 (1.12 - 1.40)	<0.001
Least poor	1.40 (1.27 - 1.54)	<0.001	1.32 (1.17 - 1.49)	<0.001
Place of residence				
Rural	1		1	
Urban	1.91 (1.80 - 2.04)	<0.001	1.47 (1.36 - 1.59)	<0.001
Year				
2011	1		1	
2012	1.08 (0.99 - 1.18)	0.094	1.05 (0.95 - 1.16)	0.347
2013	1.13 (1.04 - 1.24)	0.007	1.10 (0.99 - 1.22)	0.063
2014	0.37 (0.34 - 0.41)	<0.001	0.29 (0.26 - 0.33)	<0.001
2015	0.63 (0.57 - 0.69)	<0.001	0.56 (0.50 - 0.62)	<0.001

Discussion

The coverage of IPTp-SP, as well as the maternal characteristics associated with the use of at least one dose of IPTp-SP and three or more doses of IPTp-SP was assessed among pregnant women in Kintampo North Municipality and Kintampo South District of Ghana. The target set by Ghana National Malaria Control Program was for all pregnant women to be on IPTp-SP by the year 2015 (17). Although the coverage of at least one dose of IPTp-SP has remained high, the target set by the Ghana National Malaria Control Program was not achieved in Kintampo North Municipality and Kintampo South District.

Compared to the coverage of at least one dose of IPTp-SP, the coverage of the recommended three or more doses of IPTp-SP was lower. Also, there was no significant increase in the uptake of the recommended three or more doses of IPTp-SP after the implementation of the new policy, which required pregnant women to take at least three doses of IPTp-SP (6). Rather, the coverage of at least one dose as well as three or more doses of IPTp-SP in 2014 and 2015 was lower compared to the period preceding the implementation of the new policy. The low coverage of the recommended three or more doses of IPTp-SP has also been reported in other parts of the country (18-20). Challenges associated with the implementation of the new policy may have contributed to the low IPTp-SP coverage in 2014 and 2015. In 2014, transportation challenges as well as delays in allocating malaria commodities affected the distribution of SP to most periphery facilities in Ghana. This resulted in artificial stock outs of SP in several facilities within the country (21, 22). To help improve coverage, Ghana NMCP should ensure that at all times, all heath facilities in the country have SP in stock. Also, the low uptake of the recommended three or more doses of IPTp-SP compared to the national coverage could be due to contextual factor which might have influenced the implementation of the new policy. There is the need to further explore these contextual factors. However, this finding

emphasizes the variations in IPTp uptake in Ghana and the need for context specific interventions especially in rural settings such as the study area.

Several maternal socio-demographic characteristics were found to be associated with the uptake of at least one dose of IPTp-SP. With regards to order of pregnancy, as expected, women who have subsequent pregnancies were more likely to take at least one dose of IPTp-SP. This may be due to their knowledge and education on the benefits of IPTp-SP gained from previous pregnancies. Undoubtedly, frequency of antenatal care (ANC) attendance was found to be significantly associated with the uptake of at least one dose of IPTp-SP. This is not surprising given that IPTp-SP is a Directly Observed Therapy (DOT) administered during ANC visits.

The low uptake of the recommended three or more doses of IPTp-SP among teenage participants compared to older participants can be attributed to the low patronage of antenatal care (ANC) among teenagers. Due to the stigma associated with teenage pregnancy in Ghana, pregnant teenagers are less likely to go for ANC compared to older pregnant women (23, 24). Often, teenagers hide their pregnancies and delay in ANC attendance (24) and are therefore not able to take the recommended doses before they deliver. Given the increased risks faced by pregnant adolescents, we recommend that ANC clinics in the study area should be made adolescent friendly and should also integrate health education on the benefits of ANC visits and uptake of IPTp-SP. Likewise, parents and guardians should assist pregnant adolescents and encourage them to attend ANC as well as to educate them on the burden of malaria infection during pregnancy and the need to take the recommended number IPTp-SP doses.

Similar to the results on the uptake of at least one dose of IPTp-SP, the number of times a woman attends ANC was significantly associated with the uptake of the recommended three or more doses of IPTp-SP. A pregnant women can only take the recommended three or more doses of IPTp-SP if

she attends ANC at least three times. In Ghana, it is recommended for all pregnant women to attend ANC at least four times (5, 23). Even so, the new policy on the uptake of IPTp-SP recommends that starting as early as the beginning of the second trimester of pregnancy, SP should be administered at each scheduled ANC visit until delivery. Likewise, the policy stipulates that except in the first trimester, IPTp-SP can be administered every month with subsequent doses given at least one month apart. This implies that, more doses of IPTp-SP is recommended. Given these recommendations, it is important for pregnant women to initiate ANC visit as early as possible in order to be able take the required doses of SP.

Strategies such as Transforming IPT for Optimal Pregnancy (TIPTOP) initiative can be adopted in the study area to help increase IPTp-SP coverage. The approach of TIPTOP involves engaging community health volunteers to identify women during early stages of pregnancy, educate them on the benefits of early ANC attendance and IPTp-SP use, and to refer them to a health facility for ANC. Also, with the goal of increasing IPTp-SP coverage, volunteers of the TIPTOP initiative distribute SP to pregnant women at the community level (25). This approach to administering IPTp-SP will help increase coverage by reaching out to all pregnant women irrespective of their socio-demographic characteristic. In a study conducted in Uganda, community-based delivery of IPTp-SP was found to increase IPTp-SP coverage. Also, the administration of IPTp-SP at the community level resulted in a reduction in the prevalence of malaria parasitemia, severe anemia and low birth weight and was acceptable to about 90% of women who intend to use SP in the future (26). In addition to this approach, studies have reported that provision of incentives to pregnant women during ANC visits is associated with an increase in ANC attendance (27, 28). Hence, we propose the provision of some form of non-monetary incentives to pregnant women who attend all scheduled

ANC visits to help motivate other pregnant women to attend all scheduled ANC which may eventually lead to an increase in the coverage of IPTp-SP.

The low uptake of the recommended three or more doses of IPTp-SP among unmarried participants compared to married participants could be attributed to the possible support that married women get from their partners during pregnancy. In most rural settings in Ghana such as our study area, women largely depend on their husbands for financial support in seeking healthcare (29). Married women may have received the necessary financial support to travel to attend ANC for the recommended three or more doses of IPTp-SP considering that frequency of ANC attendance was associated with uptake of the recommended doses of IPTp-SP. The high uptake of the recommended three or more doses of IPTp-SP among educated participants compared to those with no formal education can also be attributed to how informed women with formal education are about the increased risk of malaria infection during pregnancy and the complications associated with malaria during pregnancy (30). This further reiterates the significant role education plays with regards to the use of health interventions (30). Other studies in Ghana (10) and other parts of Africa including Uganda (12) and Kenya (13, 14) also reported an association between education and the uptake IPTp-SP.

One would expect that due to the knowledge gained from past pregnancies on the importance of malaria prevention during pregnancy and the benefits of IPTp-SP, women with history of past pregnancies will take the recommended three or more doses of IPTp-SP. However, even though participants who were pregnant for the first time were more likely to take at least one dose of IPTp-SP, there was no significant association between history of past pregnancy and uptake of the recommended three or doses of IPTp-SP. Other studies in Ghana (31), and other parts of Africa including Nigeria (32) and Cameroon (33) have also reported no association between subsequent pregnancies and uptake of the recommended doses of IPTp-SP. In Ghana, association has been

reported between wealth and health, such that people with better socioeconomic status have better health seeking behaviour (34). This is reiterated in this study given that women in the higher wealth quintiles are more likely to take the recommended three or more doses of IPTp-SP. Even though IPTp-SP is provided to pregnant women free of charge, they are only given to women when they visit a health facility for ANC care. Sometimes, cost/means of transportation to the nearest ANC clinic prevent pregnant women from attending ANC (24, 35, 36). As such, women in the higher wealth quintiles are more likely to attend ANC since they may be able to bear the cost of visit to ANC clinics (36). This results is similar to that reported in the most recent Ghana Demographic and Health Survey in which the coverage of the recommended three or more doses of IPTp-SP was 50.6% and 36.6% among women in the highest wealth quintile and those in the lowest quintile respectively (37). Also, similar results have been reported in Senegal (38) where women in richer or middle wealth quintile were more likely to use the recommended doses of IPTp.

It should be emphasized that, the use of data from Health and Demographic Surveillance Systems (HDSSs) can be of great importance in informing policy makers of challenges in several health interventions. Particularly, this study used the KHDSS, by including all identified pregnant women in the study area over a five-year period. Unlike the results of cross-sectional studies, the use KHDSS has made it possible to assess and compare the coverage of IPTp-SP over a five-year period. It is also important to note that, with the use of data from all 156 communities of the KHDSS, the study findings can be generalized to all the KHDSS area and not the whole of Ghana. Also, because this study used the entire population of pregnant women, there is no bias in terms of selection of respondents. Although no pregnant woman refused participation, it is possible that a handful of pregnant women will be missed due to the approach used in identifying pregnant women. Also, the study was limited to finding the maternal characteristics associated with IPTp-SP use.

Conclusion

The use of at least one dose of IPTp-SP in the Kintampo Health and Demographic Surveillance System (KHDSS) area is generally high. However, uptake of the recommended three or more doses of IPTp-SP remains low. The study has found that, the most vulnerable pregnant women are less likely to take the recommended three or more doses of IPTp-SP. The study therefore recommends the adoption of the TIPTOP strategy to help improve the coverage of IPTp-SP in the study area.

Data sharing statement:

Data set is not publicly available. Upon request from the corresponding author, details about the statistical code and/or data set can be obtained.

Acknowledgement:

The authors are grateful to the study participants as well as the study community members. We also appreciate the effort of Abukari Mahama, Grace Manu, Francis Agbokey, Francis Dzabeng and Samuel Afari-Asiedu for their participation in the manuscript discussion meetings.

Author contributions

FBO, KPA, and SO-A conceived the idea and conceptualized the study. CZ, OEAN and EAA designed the study instrument and collected the data. SA-E and RA managed the data. The data analysis and interpretation of results was conducted by FBO, SG, DKD and KP. FBO drafted the manuscript and SG, CZ, OEAN, SA-E, EAA, DKD, RA, SO-A and KPA contributed to the revisions of the manuscript. All authors read and approved the final manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests

None declared

Ethics approval

Ethical approval was granted by the Institutional Ethics Committee of the Kintampo Health Research Centre of Ghana.

References

1. Ghana Health Service (GHS). Malaria in pregnancy training manual for health providers.
2. Desai M, ter Kuile FO, Nosten F, et al. Epidemiology and burden of malaria in pregnancy. The Lancet infectious diseases. 2007;7(2):93-104.
3. Groves J, El-Shirbiny D. Revision Notes for the DRCOG: A Textbook of Women's Health: CRC Press; 2015.
4. Garner P, Gulmezoglu A, Garner P, Gulmezoglu A. Drugs for preventing malaria in pregnant women. Cochrane Database Syst Rev. 2006;4(4).
5. World Health Organization (WHO). WHO policy brief for the implementation of intermittent preventive treatment of malaria in pregnancy using sulfadoxine-pyrimethamine (IPTp-SP). Geneva: World Health Organization. 2013.
6. Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF. Ghana Malaria Indicator Survey 2016. Accra, Ghana, and Rockville, Maryland, USA: GSS, GHS, and ICF. 2017.
7. Owusu-Agyei S, Ernest A. Nettey O, Zandoh C, et al. Demographic patterns and trends in Central Ghana: baseline indicators from the Kintampo Health and Demographic Surveillance System. Global health action. 2012;5(1):19033.
8. Kintampo Health Reseach Centre (KHRC). Kintampo Health Research Centre Annual Report 2016. 2017.
9. Asante KP, Owusu-Agyei S, Cairns M, et al. Placental malaria and the risk of malaria in infants in a high malaria transmission area in Ghana: a prospective cohort study. The Journal of infectious diseases. 2013;208(9):1504-1513.
10. Nwaefuna EK, Afoakwah R, Orish VN, Egyir-Yawson A, Boampong JN. Effectiveness of intermittent preventive treatment in pregnancy with sulphadoxine-pyrimethamine against Submicroscopic falciparum malaria in Central Region, Ghana. Journal of parasitology research. 2015;2015.
11. Hajira I. Factors Influencing Uptake of Intermittent Preventive Treatment of Malaria in Pregnancy using Sulphadoxine Pyrimethamine in the Sunyani Municipality, Ghana: University of Ghana; 2015.
12. Kiwuwa MS, Mufubenga P. Use of antenatal care, maternity services, intermittent presumptive treatment and insecticide treated bed nets by pregnant women in Luwero district, Uganda. Malaria Journal. 2008;7(1):44.
13. Eijla A, Ayisi G, Kuile F. Implementation of IPT with SP for control of malaria in Kisumu, Kenya. Malar J. 2002:265-266.
14. Ouma P, Van Eijk A, Hamel M, et al. The effect of health care worker training on the use of intermittent preventive treatment for malaria in pregnancy in rural western Kenya. Tropical Medicine & International Health. 2007;12(8):953-961.
15. Marchant T, Nathan R, Jones C, et al. Individual, facility and policy level influences on national coverage estimates for intermittent preventive treatment of malaria in pregnancy in Tanzania. Malaria Journal. 2008;7(1):260.
16. Liang K-Y, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika. 1986;73(1):13-22.
17. Owusu-Boateng I, Anto F. Intermittent preventive treatment of malaria in pregnancy: a cross-sectional survey to assess uptake of the new sulfadoxine–pyrimethamine five dose policy in Ghana. Malaria journal. 2017;16(1):323.

18. Doku DT, Zankawah MM, Adu-Gyamfi AB. Factors influencing dropout rate of intermittent preventive treatment of malaria during pregnancy. BMC research notes. 2016;9(1):460.
19. Tutu EO, Lawson B, Browne E. The effectiveness and perception of the use of sulphadoxine-pyrimethamine in intermittent preventive treatment of malaria in pregnancy programme in Offinso District of Ashanti Region, Ghana. Malaria journal. 2011;10(1):385.
20. Hommerich L, Von Oertzen C, Bedu-Addo G, et al. Decline of placental malaria in southern Ghana after the implementation of intermittent preventive treatment in pregnancy. Malaria Journal. 2007;6(1):144.
21. Odjidja EN. Low Uptake of Intermittent Preventive Treatment in Ghana; An Examination of Health System Bottlenecks. ARCHIVOS DE MEDICINA. 2017;4(3):60.
22. Ghana National Malaria Control Program (GNMC). 2014 Annual Report National Malaria Control Programme. January 2015.
23. Ghana Health Service (GHS). Family Health Division Annual Report 2016. 2017.
24. Pell C, Meñaca A, Were F, et al. Factors affecting antenatal care attendance: results from qualitative studies in Ghana, Kenya and Malawi. PloS one. 2013;8(1):e53747.
25. JHPIEGO. Community Intermittent Preventive Treatment for Malaria in Pregnancy Implementation Guide Version 2. November 2018.
26. Mbonye AK, Bygbjerg I, Magnussen P. Intermittent preventive treatment of malaria in pregnancy: a community-based delivery system and its effect on parasitemia, anemia and low birth weight in Uganda. International Journal of Infectious Diseases. 2008;12(1):22-29.
27. Khogali M, Zachariah R, Reid A, et al. Do non-monetary incentives for pregnant women increase antenatal attendance among Ethiopian pastoralists? Public health action. 2014;4(1):12-14.
28. Till SR, Everetts D, Haas DM. Incentives for increasing prenatal care use by women in order to improve maternal and neonatal outcomes. Cochrane Database of Systematic Reviews. 2015(12).
29. Opoku G. Review of Maternal Mortality and Near-Miss Events in Kintampo Municipality in the Brong Ahafo Region of Ghana. Texila International Journal of Public Health. Dec 2016 4(5).
30. Hill J, Hoyt J, van Eijk AM, et al. Factors affecting the delivery, access, and use of interventions to prevent malaria in pregnancy in sub-Saharan Africa: a systematic review and meta-analysis. PLoS medicine. 2013;10(7):e1001488.
31. Ibrahim H, Maya ET, Issah K, Apanga PA, Bachan EG, Noora CL. Factors influencing uptake of intermittent preventive treatment of malaria in pregnancy using sulphadoxine pyrimethamine in Sunyani Municipality, Ghana. Pan African Medical Journal. 2017;28(122).
32. Amoran OE, Ariba AA, Iyaniwura CA. Determinants of intermittent preventive treatment of malaria during pregnancy (IPTp) utilization in a rural town in Western Nigeria. Reproductive health. 2012;9(1):12.
33. Takem EN, Achidi EA, Ndumbe PM. Use of intermittent preventive treatment for malaria by pregnant women in Buea, Cameroon. Acta Tropica. 2009;112(1):54-58.
34. Danso-Appiah A, Stolk WA, Bosompem KM, et al. Health seeking behaviour and utilization of health facilities for schistosomiasis-related symptoms in Ghana. PLoS neglected tropical diseases. 2010;4(11):e867.
35. Andrew EV, Pell C, Angwin A, et al. Factors affecting attendance at and timing of formal antenatal care: results from a qualitative study in Madang, Papua New Guinea. PloS one. 2014;9(5):e93025.
36. Arthur E. Wealth and antenatal care use: implications for maternal health care utilisation in Ghana. Health economics review. 2012;2(1):14.

37. Ghana Statistical Service, Ghana Health Service (GHS), ICF International. Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: GSS, GHS, and ICF International. Available at http://www.statsghana.gov.gh/docfiles/publications/2014%20GDHS%20%20Report.pdf. Accessed on 29th Septemebr, 2018. 2015.
38. Mbengue MAS, Bei AK, Mboup A, et al. Factors influencing the use of malaria prevention strategies by women in Senegal: a cross-sectional study. Malaria journal. 2017;16(1):470.

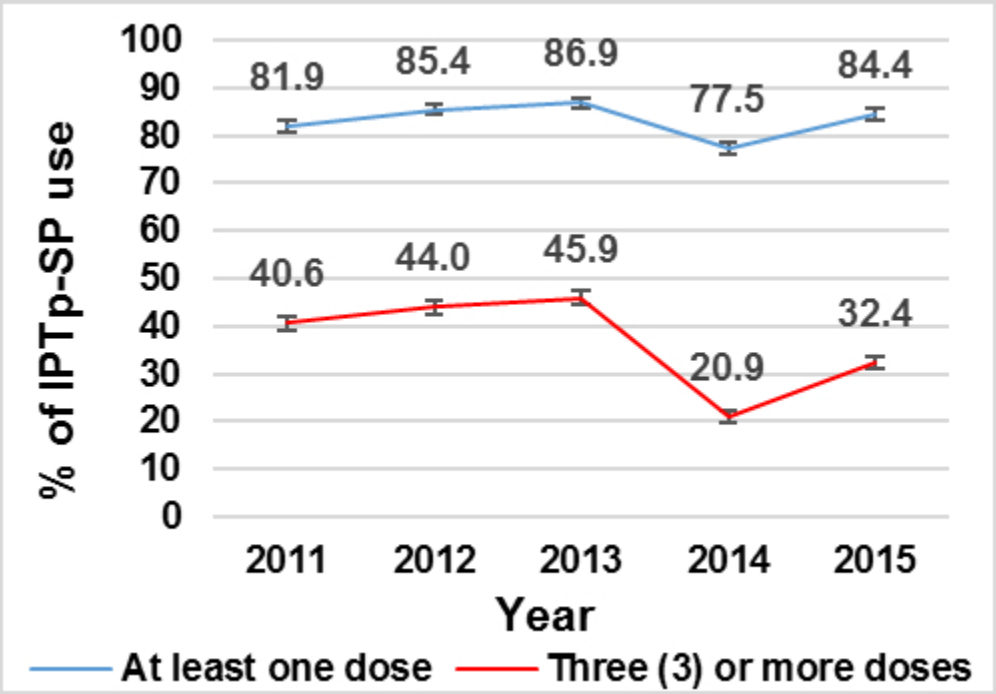

Figure 1. Doses of IPTp-SP taken by pregnant women in the Kintampo North Municipality and Kintampo South District from 2011 to 2015