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Examining Behavioral, Accessibility, and Sociodemographic Influences on Uptake of Intermittent Preventive Treatment of Malaria in Pregnant Women (IPTp) and Antenatal Care (ANC) Attendance

By

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Global Epidemiology

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By

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Bachelor of Science
University of Georgia
2018

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Abstract

Examining Behavioral, Accessibility, and Sociodemographic Influences on Uptake of Intermittent Preventive Treatment of Malaria in Pregnant Women (IPTp) and Antenatal Care (ANC) Attendance

By Eva Rodriguez

Background: Sub-Saharan Africa carries much of the global malaria burden, heavily impacting pregnant women. IPTp-SP is a recommended practice for prevention of malaria in pregnant women. We analyzed data to understand the behavioral components that may influence the uptake and effectiveness of IPTp-SP, and to better understand how to target these in order to improve uptake.

Methods: A cross-sectional study of a random sample of women who delivered within the previous 12 months was conducted in Geita, Tanzania to assess the number of doses of IPTp and number of ANC visits women received during pregnancy, at two timepoints: November-December 2019 and June-July 2021. The primary outcomes in this study were the proportion of women who attended at least 4 ANC visits (ANC4) and the proportion who received the recommended 3 or more doses of IPTp (IPTp3). Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using a logistic regression model for both outcomes in the bivariate and multivariate analyses.

Results: 33% of women received IPTp3. Factors positively associated with IPTp3 included: education, favorable attitude towards IPTp, knowledge of IPTp and ANC, and perception of IPTp use as a community norm. Women were less likely to receive IPTp3 if they were in their third trimester at their first ANC visit and had to travel more than 5 kilometers to the health facility. 42.08% of women attained ANC4. Women with an education, married and living with their spouse were statistically significantly more likely to obtain ANC4 attendance than those with no education. Women were statistically significantly less likely to attain ANC4 attendance if they were in their second and third trimesters at first ANC, if they lived 5 kilometers or more away from the health facility, and if they had 3 or more living children.

Conclusion: We identified additional behaviors associated with IPTp uptake, including a favorable attitude towards IPTp, perception of IPTp effectiveness, and perception of the threat of malaria. Communication and engagement between ANC health workers and the community must be enhanced to properly inform women about IPTp and address negative perceptions surrounding IPTp.

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I. Literature Review

Background

Malaria is a life-threatening disease caused by infection with *Plasmodium* species parasites that has remained a major public health concern for many decades. Sub-Saharan Africa disproportionately carries much of the global malaria burden, with children under five and pregnant women at the highest risk for adverse consequences of infection [1]. Malaria infections in pregnant women carry significant risks and consequences for the mother and baby at all stages of pregnancy, commonly resulting in poor birth outcomes (e.g., low birth weight) that can affect the baby after birth [2]. The World Health Organization recommends that all pregnant women in areas with moderate to high malaria transmission, which includes most of sub-Saharan Africa, receive intermittent preventive treatment for malaria in pregnancy (IPTp) with sulfadoxine-pyrimethamine (SP) [3]. IPTp-SP is an effective preventive treatment for curtailing the burden of malaria in pregnancy in Sub-Saharan Africa. However, despite implementation of the WHO policy for over a decade, uptake and coverage of IPTp-SP remains low, with only 32% of women in sub-Saharan Africa receiving the recommended three or more doses of IPTp (IPTp3) [4], far below international targets of 80% [5].

A prior review of the barriers and facilitators to IPTp uptake published in 2013[6] found a number of consistent barriers across countries, including lack of knowledge, gender roles, societal & cultural norms, lack of physical access/ transportation, and many others. It is important to understand what has changed overtime in the effects these potential factors have on both IPTp uptake and antenatal care (ANC) attendance.

Burden of Malaria in Tanzania

Tanzania accounts for the third highest annual malaria deaths worldwide. There are about 1.7 million cases of malaria in pregnant women per year in Tanzania [7]. Tanzania has seen a 45% decline in overall under-five mortality between 1999 and 2010 and a 55% decline in mortality among infants aged 1 to 23 months as a result of malaria control interventions; however, over 90% of Tanzania's population remains at risk of transmission [8, 9]. Malaria in pregnant women is a persisting issue, in Tanzania with a 2017 study reporting a 6.8% prevalence of malaria in women at their first ANC visit [10].

Factors Influencing Antenatal Care Attendance

Adequate ANC attendance has been defined by the WHO as a minimum of four or more visits (ANC4), although newer recommendations are for eight or more visits [11]. ANC is a primary source for pregnant women to obtain resources about malaria prevention [3]. Affordability is a major contributor to proper utilization of ANC and other preventive resources. In previous studies, women who could not afford ANC were found to not achieve adequate ANC attendance [12, 13].

IPTp uptake is highly contingent on levels of ANC attendance, and health facility accessibility is a major factor influencing ANC attendance. In Madagascar, long distance from a women's home to the health facility was a barrier to achieving adequate ANC attendance [14]. Additionally, studies in Uganda, Ghana, Kenya, and Malawi have all demonstrated accessibility to the facility to be associated with achieving adequate ANC [15, 16]. In Tanzania, closer distance travelled to ANC, shorter wait times at ANC, initiation of ANC before 20 weeks gestation, and having a

basic knowledge about ANC was associated with achieving ANC4 in a 2019 study [17].

Operationally, effective communication between health workers and women seeking treatment at ANC is important for ANC retention and success [18]. Other findings suggest that ANC attendance among pregnant women may be improved by targeting their male partners through programming, improving accessibility, and addressing health system factors such as clinic operations and adequate staffing [19]. However, more studies are needed to examine factors influencing ANC attendance, and how to overcome barriers to ensure optimal ANC attendance and effective delivery of core interventions.

While adequate ANC attendance is a pre-requisite for optimal IPTp-SP uptake [17, 20-30], coverage of IPTp3 remains low in many areas, including Tanzania, despite a high level of ANC attendance [31-33].

Factors Influencing IPTp-SP Utilization

Studies conducted throughout sub-Saharan Africa have found that age, marital status, husband's support, accessibility to health facilities, and patient behaviors influence the inequality of opportunity for IPTp-SP uptake [22, 24, 34-47]. Overall, studies show that women less than 20 years old were generally the least likely to receive 3 doses of IPTp-SP during pregnancy, whereas women aged 25-34 years, and particularly those aged 25-29 years, were most likely to receive treatment [38-41, 44, 48-50]. In general, married women were more likely to receive an adequate number of IPTp-SP doses than those who were single [24, 35, 38, 41, 46].

Accessibility to health facilities is also an important factor impacting IPTp-SP uptake. In Burundi, a shorter travel distance from the mother's home to the health facility was associated

with higher IPTp-SP uptake [46]. This is consistent with results from a household survey in Mali, which found that the presence of a health facility in the village was associated with higher IPTp-SP uptake among those living in the village [51].

Patient behaviors and attitudes are suspected to have a significant influence on adequate IPTp uptake. A study in the Soroti district of Uganda reported that IPTp-SP uptake was less likely among respondents who perceived IPTp side effects as a threat. Women who were knowledgeable about the treatment and malaria, as well as those who had support from their peers, were more likely to achieve adequate IPTp-SP uptake [47]. Similarly, studies conducted in Kenya, Uganda, and Mali all found that women who had good knowledge of the recommended number of IPTp-SP doses and benefits had better uptake of IPTp-SP [27, 51, 52]. Although many studies find that knowledge levels and behaviors influence IPTp-SP uptake, this is not consistent. A study in Nigeria reported that perceptions about IPTp-SP were not constraining factors to increased coverage[53].

Summary of Current Problem and Study Relevance

IPTp-SP is a recommended practice for prevention of malaria in pregnant women. Additionally, even with an effective drug regimen and relatively high ANC attendance, poor uptake can lead to reductions in IPTp-SP effectiveness. Understanding the factors affecting both ANC attendance and uptake of IPTp-SP are critical to inform policy recommendations. It is also important to understand the behavioral components, such as patient knowledge, perceptions, and peer support engagement, of the women receiving IPTp-SP that may influence the uptake and effectiveness of IPTp-SP, to better understand how to target these to improve uptake. Demographic factors

associated with improved uptake of IPTp have been well documented, but there are fewer studies looking at behavioral factors, which may be more amenable to interventions. With the high burden of malaria in pregnancy in sub-Saharan Africa, and low coverage of IPTp3, despite overall high ANC attendance, it is important to evaluate potential modifiable influencing factors.

II. Methods

Study Design

Data were collected as part of a larger study in Geita Region, in northwest Tanzania (Figure 1), designed to assess the impact of group antenatal care on the uptake of all ANC interventions. Geita Region is divided into six councils, Geita Town, and 5 district councils: Geita, Bukombe, Chato, Mbogwe, and Nyang'hwale; the study was conducted in all six councils. In 2022, the population of Geita Region was 2,977,608 [54]. The region is home to Tanzania's largest gold mining industries, with other major industries including agriculture and fishing. The region is highly endemic for malaria, with perennial transmission, which peaks shortly after the wet seasons (February to May and September to December).

A cross-sectional study of a random sample of women who delivered within the previous 12 months was conducted to assess the number of doses of IPTp and number of ANC visits women received during pregnancy. Additionally, the survey collected demographic data as well as women's knowledge, perceptions, and ideational factors related to malaria in pregnancy and ANC attendance. Where available, data from patient carried ANC cards were recorded; self-report was used when ANC cards were not available. Ministry of health ANC cards are routinely filled out by healthcare providers at each visit, and are validated as a reliable source of information about prenatal care in this setting [55]. Data were collected at two points in time: November-December 2019 and June-July 2021. The purpose of this analysis was to assess how behavioral and ideational factors and distance to facilities affect women's care-seeking (ANC) and subsequently IPTp uptake.

Figure 1. Geita region located in Northwest Tanzania

Sampling and Eligibility

Sampling was based on the primary objective of assessing the effect of group ANC. The study included a total of 40 health facilities randomly selected from facilities with monthly attendance of approximately 50-120 first ANC visits per month. Facilities that were not easily accessible, did not have adequate space for group meetings, or were not interested in offering group ANC were excluded. From the catchment area of each facility, one Enumeration Area (EA) was selected at random for the cross-sectional survey. Each selected EA was mapped, and eligible women (aged 15-49 years, had delivered a live born infant in the previous 12 months) were selected at random. Selected women were included in the baseline and endline surveys if they provided written consent to participate.

The sample size was initially calculated for the purpose of assessing the group ANC intervention, so the sample size was not changed to examine this secondary objective.

Defined Outcomes

The two primary outcomes in this study were the proportion of women who attended at least 4 ANC visits (ANC4) and the proportion who received the recommended 3 or more doses of IPTp

(IPTp3).

Potential Predictors

The following independent variables were evaluated as potential predictors of ANC4 and IPTp3: behavior ideation factors (favorable attitude toward ANC/IPTp, decision making, basic knowledge on ANC/IPTp, perception of community norms for ANC/IPTp, perception of IPTp effectiveness, perception of risk of malaria), woman's age, distance travelled to health facility (calculated as the Euclidean distance between the house and assigned health facility), gravidity, education, wait time at health facilities, gestational age at first ANC, and district.

Statistical Analysis

All statistical analyses were performed using SAS, version 9.4 (SAS Institute, Cary, NC). Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using a logistic regression model for both outcomes. Bivariate analyses, controlling for timepoint (data collected in 20XX vs. 20YY), were performed for all independent variables. Potential predictors significant at the 5% level ($p < 0.05$) in the bivariate analyses were included in the multivariate models. The final multivariate analyses were obtained for both outcomes, ANC4 and IPTp3, using backwards elimination, with a p-value threshold of X% to be retained in the model. IRB approval was previously obtained to conduct the study for the purpose of the primary and secondary objectives; all data has been de-identified, so IRB approval was not required for the present analysis.

III. Results

A total of 2,217 women participated in the cross-sectional surveys – 1,156 in the baseline survey and 1,061 in the endline survey. Demographic characteristics of the participating women were similar for the baseline and endline surveys (Table 1). The mean age of the participants was 27.12 (SD 6.76), and the majority of the women (75%) were between the ages of 20 and 35 years.. The majority of the participants were married and living together with their spouses (n=1910, 86.15%) and had 3 or more children (n=1400, 63.64%). Approximately half of the women (57.42%) attained a primary education, 9.07% held a secondary education or higher, and roughly one-third (33.5%) had no education. Half of the women were in their second trimester of their pregnancy at their first ANC visit, and approximately half lived within 5 kilometers of the health facility.

Table 1. Characteristics of participants and IPTp-SP dose status and ANC attendance at baseline and endline

	Total	Baseline Survey	Endline Survey	p-value
N (%)	**2217**	**1156**	**1061**	
Age, n (%)				0.15
<20	**263 (12)**	**152 (13)**	**111 (10)**	
20-35	**1656 (75)**	**852 (74)**	**804 (76)**	
36+	**298 (13)**	**152 (13)**	**146 (14)**	
Mean Age, years (std)	**27.12 (6.76)**	**26.98 (6.80)**	**27.23 (6.72)**	0.29
Marital Status				0.58
Never Married	**163 (7)**	**88 (8)**	**75 (7)**	
Married/Living Together	**1910 (86)**	**990 (86)**	**920 (87)**	
Widowed	**13 (1)**	**5 (0.4)**	**8 (1)**	
Divorced/Separated	**131 (6)**	**73 (6)**	**58 (5)**	
Education Level				0.42
No education	**743 (34)**	**375 (32)**	**368 (35)**	
Primary	**1273 (57)**	**679 (59)**	**594 (56)**	
Secondary or Higher	**201 (9)**	**102 (9)**	**99 (9)**	
Gestational Age at first ANC				**<.0001**
First Trimester	**717 (32)**	**187 (16)**	**530 (50)**	
Second Trimester	**1122 (51)**	**759 (66)**	**363 (34)**	
Third Trimester	**378 (17)**	**210 (18)**	**168 (16)**	
District				0.62
Geita	**689 (31)**	**375 (33)**	**314 (30)**	
Bukombe	**167 (7)**	**85 (7)**	**82 (8)**	
Chato	**720 (33)**	**364 (32)**	**356 (33)**	
Mbogwe	**438 (20)**	**222 (19)**	**216 (20)**	
Nyang'hwale	**197 (9)**	**104 (9)**	**93 (9)**	
Gravidity				0.98
Primigravidae	**416 (19)**	**217 (19)**	**199 (19)**	
Secondigravidae	**384 (17)**	**200 (18)**	**184 (17)**	
Multigravidae	**1400 (64)**	**724 (63)**	**676 (64)**	
Distance Travelled to Health Facility (kilometers)				0.66
≤ 5	**996 (50)**	**560 (50)**	**436 (49)**	
5+	**1001 (50)**	**553 (50)**	**448 (51)**	
IPTp Status				**<.0001**
< 3	**1493**	**636**	**857**	
3+	**724**	**520**	**204**	
ANC Attendance				0.97
< 4	**1282**	**668**	**614**	
4+	**933**	**487**	**446**	

Factors associated with IPTp3+

Bivariate analyses

Overall, 33% of women received the recommended 3 doses of IPTp (Table 2). IPTp3+ coverage was statistically significantly higher among those who had a favorable attitude towards treatment

(OR: 1.5, 95% CI: 1.2-1.9). All but two women (2,215/2,217; 99.9%) reported making their own decisions on IPTp, and most women (2,082/2,217; 93.9%) were confident that they could go to ANC and take IPTp.; thus we could not evaluate the impact of either of these factors on IPTp3+ coverage. Women who had basic knowledge about and favorable perception of the community norms of IPTp and ANC were more likely to receive IPTp3+ (OR: 2.0, 95% CI: 1.7-2.5; OR: 1.7, 95% CI: 1.4-2.2, respectively). Those who perceived IPTp as effective or felt that the potential for malaria was a threat were more likely to receive IPTp3+ (OR: 2.0, 95% CI: 1.2-3.3; OR: 2.0, 95% CI: 1.4-2.8, respectively).

Age, marital status, number of children, wait time at facility, and district were not predictive of uptake of IPTp3+. Women who had any education were more likely to receive IPTp3+ than those who had no education (primary education – OR: 1.4, 95% CI: 1.2-1.8; secondary or higher education – OR: 1.8, 95% CI: 1.3-2.6; overall). Women who began ANC in their third trimester were less likely to receive IPTp3+ than those who initiated ANC earlier in their pregnancies (OR: 0.3, 95% CI: 0.2-0.4,). Those who had to travel more than 5 kilometers to the health facility were also less likely to receive IPTp3+ than those who traveled shorter distances (OR: 0.7, 95% CI: 0.6-0.9).

Multivariate analysis

Variables included in the final multivariate model were women who had a favorable attitude towards IPTp, basic knowledge of IPTp and ANC, perception of IPTp use as a community norm, education level, gestational age at first ANC visit, distance traveled to health facility, and gravidity. The remaining predictors (decision making on treatment, perception of IPTp

effectiveness, self-efficacy to take IPTp, perceived risk of malaria, age, marital status, wait time at facility, and district) were ultimately dropped from the final model since their p-values all exceeded the threshold for inclusion ($p < 0.05$). Although it was not statistically significant in the IPTp3+ model, gravidity was included in both final models for ANC4+ and IPTp3+ outcomes as previous studies have proven that women with only one child are more likely to receive IPTp3+ than women with more than one child [56, 57]. This is important to include in the final model, as it should be considered as a potential factor to consider for future recommendations for interventions and programming. Patient behaviors associated with an increased likelihood of achieving IPTp3+ included: having a favorable attitude towards IPTp (aOR: 1.4, 95% CI: 1.1-1.9), basic knowledge of IPTp and ANC (aOR: 1.9, 95% CI: 1.5-2.4), and perception that IPTp use as a community norm (aOR: 1.6, 95% CI: 1.2-2.0). Women who had a primary or secondary/higher education (aOR: 1.3, 95% CI: 1.0-1.7; aOR: 1.8, 95% CI: 1.3-2.6) were more likely to receive IPTp3+. After adjusting for all other predictors, women were less likely to receive IPTp3+ if they were in their third trimester at their first ANC visit (aOR: 0.3, 95% CI: 0.2-0.4), as were those who had to travel more than 5 kilometers to the health facility (aOR: 0.8, 95% CI: 0.6-1.0).

Table 2. Factors influencing IPTp3 uptake, including timepoint of survey as a covariate

Label	IPTp status		Bivariate*				Multivariate*			
	IPTp <3	IPTp 3+								
	n= 1493	n= 724	Odds Ratio	95% Confidence Limits		Pr > | Z |	Odds Ratio	95% Confidence Limits		Pr > | Z |
Patient Behaviors										
Favorable attitude towards IPTp	1116 (75)	570 (79)	1.5	1.2	1.9	**0.001**	1.4	1.1	1.9	**0.006**
Decision making on treatment	1492 (100)	723 (100)	1.5	0.19	12.6	0.63				
Baisc knowledge of IPTp and ANC	724 (50)	485 (67)	2.0	1.7	2.5	**<.0001**	1.9	1.5	2.4	**<.0001**
Perceived community norms of IPTp and ANC	1109 (74.28)	589 (81)	1.7	1.4	2.2	**<.0001**	1.6	1.2	2.1	**0.001**
IPTp perceived as effective	1420 (95)	700 (97)	2.0	1.2	3.3	**0.007**				
Confidence in self efficacy of IPTp	1397 (94)	685 (95)	1.5	1.0	2.2	0.07				
Perceived risk of Malaria	1326 (89)	672 (93)	2.0	1.4	2.8	**0.0002**				
Age, years						0.33				
< 20	183 (12)	80 (11)								
20 - 35	1114 (75)	542 (75)	1.2	0.90	1.6					
36+	196 (13)	102 (14)	1.3	0.90	1.9					
Marital Status						0.89				
Never Married	112 (7)	51 (7)								
Married/Living Together	1283 (86)	627 (7)	1.1	0.77	1.6					
Widowed	10 (1)	3 (0.4)	0.78	0.19	3.2					
Divorced/Separated	88 (6)	43 (6)	1.1	0.63	1.8					
Education Level						**0.0005**				**0.03**
No education	542 (36)	201 (28)								
Primary	829 (56)	444 (61)	1.4	1.2	1.8		1.3	1.0	1.7	
Secondary or Higher	122 (8)	79 (11)	1.8	1.3	2.6		1.5	1.0	2.3	
Gestational Age at first ANC						**<.0001**				**<.0001**
First Trimester	515 (34)	202 (28)								
Second Trimester	652 (44)	470 (65)	1.1	0.87	1.4		1.2	0.93	1.5	
Third Trimester	326 (22)	52 (7)	0.26	0.18	0.37		0.28	0.19	0.42	
Distance traveled to health facility, kilometers						**0.003**				**0.03**
≤ 5	626 (47)	370 (56)								
5+	709 (53)	292 (44)	0.69	0.55	0.85		0.76	0.60	1.0	
Gravidity						0.84				0.34
Primigravida or Secondigravida	537 (36)	263 (37)								
Tertigravida or more	947 (64)	453 (63)	1.0	0.80	1.2		1.1	0.89	1.4	
Patient wait at facility, minutes						0.05				
< 120	506 (36)	256 (39)								
120 - 239	632 (46)	291 (44)	0.91	0.73	1.1					
240+	247 (18)	115 (17)	0.70	0.53	0.94					
District						0.72				
Geita	478 (32)	211 (29)								
Bukombe	112 (8)	55 (8)	1.0	0.61	1.6					
Chato	469 (31)	251 (35)	1.1	0.83	1.5					
Mbogwe	310 (21)	128 (18)	1.0	0.69	1.4					
Nyang'hwale	123 (8)	74 (10)	1.3	0.83	2.0					

*** all models included timing of the survey as a covariate**

Factors associated with ANC4+

Bivariate analyses

Overall, 42.08% (n=933) of women attended four or more ANC visits (Table 3). Women who had a basic knowledge of IPTp and ANC, and those who had a favorable attitude towards IPTp were more likely to have 4 or more ANC visits (OR: 1.3, 95% CI: 1.1-1.5; OR: 1.3, 95% CI: 1.0-1.6, respectively) Those with a secondary or higher education level were statistically

significantly more likely to attend 4+ ANC visits than those with no education (OR: 2.6, 95% CI: 1.9-3.6). Factors not associated with ANC4+ included: perception of taking IPTp to be a community norm, decision making, perception of IPTp efficacy, confidence in self-efficacy, perception of malaria, 36 years of age or older, travelling more than 5 kilometers to the health facility, late initiation of ANC, having 3 or more children, and health facility wait time of 240 minutes or more, district, and marital status.

Multivariate analysis

After assessing the significance of the behavioral factors including all factors found to be statistically significant in bivariate analysis, none of the behavioral factors remained statistically significant (attitude towards IPTp, decision making on treatment, basic knowledge of IPTp and ANC, perceived community norms of IPTp and ANC, perception of IPTp effectiveness, confidence in self-efficacy of IPTp, perception of malaria as a threat). Patient age, wait time at health facility, and district were also dropped from the final multivariate model because they were not statistically significant.

Thus, the final model included the following factors: education level, marital status, gestational age at first ANC, distance traveled to the health facility, and gravidity. Women with a primary and secondary or higher education level were statistically significantly more likely to obtain ANC4+ attendance than those with no education (primary education – adjusted OR (aOR): 1.3, 95% CI: 1.0-1.6; secondary or higher education - aOR: 2.5, 95% CI: 1.7-3.7). Women who were married and living with their spouse were statistically significantly more likely to obtain ANC4+ than those who were never married (aOR: 1.7, 95% CI: 1.2-2.6). After adjusting for the other predictors, women were statistically significantly less likely to attain ANC4+ attendance if they

were in their second and third trimesters at first ANC visit (second vs. first trimester – aOR: 0.4, 95% CI: 0.4-0.6; third vs. first trimester – aOR: 0.05, 95% CI: 0.03-0.08), if they lived 5 kilometers or more away from the health facility (OR: 0.5, 95% CI: 0.4-0.7), and if they had 3 or more living children (OR: 0.79, 95% CI: 0.63-1.0).

Table 3. Factors influencing ANC attendance, including timepoint of survey as a covariate

Label	ANC Attendance		Bivariate*				Multivariate*			
	ANC < 4	ANC 4+								
	n= 1282	n= 933	Odds Ratio	95% Confidence Limits		Pr > | Z |	Odds Ratio	95% Confidence Limits		Pr > | Z |
Patient Behaviors										
Favorable attitude towards IPTp	952 (74)	733 (79)	1.3	1.0	1.6	**0.02**				
Decision making on treatment	1281 (100)	932 (100)	4.4	0.31	62	0.22				
Baisc knowledge of IPTp and ANC	667 (52)	542 (58)	1.3	1.1	1.5	**0.007**				
Perceived community norms of IPTp and ANC	975 (76)	722 (77)	1.1	0.88	1.3	0.47				
IPTp perceived as effective	1217 (95)	901 (97)	1.5	1.0	2.4	0.07				
Confidence in self efficacy of IPTp	1200 (94)	880 (94)	1.1	0.78	1.6	0.49				
Perceived risk of Malaria	1146 (89)	850 (91)	1.2	0.90	1.6	0.19				
Age, years						**0.02**				
< 20	153 (12)	110 (12)								
20 - 35	934 (73)	721 (77)	1.1	0.82	1.4					
36+	195 (15)	102 (11)	0.73	0.51	1.0					
Marital Status						0.07				**0.008**
Never Married	105 (8)	58 (6)								
Married/Living Together	1086 (85)	822 (88)	1.4	1.0	1.9		1.7	1.2	2.6	
Widowed	11 (1)	2 (0.2)	0.33	0.07	1.6		0.42	0.08	2.4	
Divorced/Separated	80 (6)	51 (5)	1.2	0.71	1.9		1.2	0.66	2.0	
Education Level						**<.0001**				**<.0001**
No education	463 (36)	279 (30)								
Primary	741 (58)	531 (57)	1.2	1.0	1.4		1.3	1.0	1.6	
Secondary or Higher	78 (6)	123 (13)	2.6	1.9	3.6		2.5	1.7	3.7	
Gestational Age at first ANC						**<.0001**				**<.0001**
First Trimester	301 (23)	415 (44)								
Second Trimester	630 (49)	491 (53)	0.49	0.40	0.61		0.45	0.35	0.56	
Third Trimester	351 (27)	27 (3)	0.05	0.03	0.08		0.05	0.03	0.08	
Distance traveled to health facility, kilometers						**<.0001**				**<.0001**
≤ 5	489 (43)	507 (60)								
5+	657 (57)	342 (40)	0.50	0.41	0.61		0.53	0.42	0.66	
Gravidity						**<.0001**				**0.04**
Primigravida or Secondigravida	408 (32)	392 (42)								
Tertigravida or more	865 (68)	533 (58)	0.64	0.54	0.77		0.79	0.63	1.0	
Patient wait at facility, minutes						**0.048**				
< 120	423 (36)	339 (39)								
120 - 239	529 (45)	392 (46)	0.92	0.76	1.1					
240+	230 (19)	132 (15)	0.72	0.55	0.93					
District						0.29				
Geita	372 (29)	317 (34)								
Bukombe	102 (8)	65 (7)	0.70	0.42	1.2					
Chato	419 (33)	300 (32)	0.89	0.66	1.2					
Mbogwe	277 (22)	161 (17)	0.73	0.51	1.0					
Nyang'hwale	19 (8)	87 (10)	1.0	0.67	1.6					

*** all models included timing of the survey as a covariate**

IV. Discussion

Although ANC attendance was relatively high in this sample of women from the Geita region of Tanzania (98.2% attended at least 1 ANC visit), issues with achieving the recommended number of ANC visits and IPTp uptake persisted. Only 42% of women in this sample attended 4 or more ANC visits, and only 33% received 3 or more doses of IPTp. Since ANC visits are a prerequisite for IPTp, the low coverage of IPTp3 can partially be explained by the low prevalence of ANC4. We identified several behavioral, sociodemographic, and accessibility factors that may serve as predictors for successful ANC attendance and IPTp uptake, including: attitude towards IPTp, decision making, knowledge, perception of community norms, perceived efficacy of IPTp, confidence in self-efficacy, perceived risk of malaria, age, marital status, education level, gestational age at first ANC, distance travelled to the health facility, gravidity, wait time at health facility, and district location.

Other studies report age, accessibility to health facilities, and patient behaviors as predictors for IPTp-SP uptake [22, 24, 34-47]. Similar to other studies, we found several patient behaviors to be important predictors of IPTp3+: a favorable attitude towards IPTp, basic knowledge of IPTp and ANC, perception that taking IPTp is a community norm, perception of IPTp effectiveness, and perception of the threat of malaria were all found to be statistically significant predictors for uptake of 3 or more doses of IPTp. Each of these patient behaviors nearly doubled the likelihood of IPTp3+ uptake. More studies that examine how to influence the specified attitudes, perceptions, and behaviors are needed. The importance of this finding cannot be overstated when it comes to future targeted programing and interventions: ensuring that women are prepared for and understand the treatment process will aid in ensuring they attain enough IPTp doses. Programs aimed at increasing uptake of IPTp should focus initially on engagement and

attendance of ANC, since this is a required step for IPTp initiation. An abundance of literature suggests that through community mobilization and ANC, women can become more educated about IPTp and the importance of adequate uptake [36, 58, 59]. The national guidelines and recommendations regarding IPTp must be clearly communicated and consistently implemented throughout the community, through trusted community members, leaders, and stakeholders that interact with pregnant women. The more pregnant people understand about the treatment, the more likely they will be to prioritize treatment and receive adequate doses.

Community education and engagement programs regarding IPTp would also help to address the hesitancy and social acceptability surrounding the treatment. Our study demonstrated that those who perceived taking IPTp to be a community norm and who had a favorable attitude towards the treatment overall were more likely to receive adequate doses. Such issues regarding stigma and misunderstandings surrounding IPTp often arise from the women not being properly educated about IPTp; community delivery and emphasis regarding the importance of receiving adequate doses of IPTp at the first ANC visit or interaction with the women could aid in achieving adequate IPTp in larger numbers[57]. If women feel more open to ask questions about the treatment, some of the concerns and perceptions that have shown to limit adequate IPTp uptake may be resolved. In addition to communication with health workers, peer engagement and support structures, such as group ANC, should also aim to address rumors or concerns women may have about IPTp treatments [60]. Listening to other women express common fears and experiences may improve the sense of companionship and help women not to feel isolated [47].

Consistent with our study, long distance from a women's home to the health facility has been shown to be a barrier to achieving adequate ANC attendance [14], and better access to care

(defined as traveling a shorter distance to the clinic) has been associated with achieving ANC4 [17]. This suggests that improving accessibility to ANC by removing barriers to ANC attendance could improve intervention uptake. This could include having community health workers deliver components of ANC in the community, as recommended by WHO [11] or by implementing intermittent mobile ANC in communities.

V. Conclusion

Despite relatively high ANC attendance [31-33], issues with achieving ANC4+ and IPTp3+ uptake persist. Previous studies examined only a few patient behaviors, such as knowledge and community norms. We identified additional behaviors associated with IPTp uptake, including a favorable attitude towards IPTp, perception of IPTp effectiveness, and perception of the threat of malaria. Examining more specific patient attitudes and perceptions helps get a better picture of how these factors could be targeted to improve uptake. To ensure adequate ANC attendance and subsequent IPTp uptake, programs educating women on ANC and IPTp as well as enhanced accessibility to health facilities are needed. Communication and engagement between ANC health workers and the community must be enhanced to properly inform women about IPTp and address negative perceptions surrounding IPTp. Future studies should examine similar factors across sub-Saharan Africa to better understand how behaviors can be improved to enhance uptake of ANC and IPTp, and whether this differs by other factors, including geographic location. In particular, studies should assess the impact of various behavioral interventions, to determine how best to drive desirable behaviors.

VI. Public Health Implications

Our findings suggest that ANC attendance and IPTp uptake are influenced by patient knowledge and behaviors as well as health facility accessibility. While changing behavior is difficult, it can be targeted through education and behavior change communication. Further research is needed to explore how to deliver messaging most effectively to women, and whether there are other family members (e.g., husbands, mothers-in-law) who should be included in this messaging to promote behavior change. These efforts are needed to refine interventions to improve the reach and effectiveness of IPTp programs and ensure successful IPTp implementation and coverage across sub-Saharan Africa.

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