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Community-Based Promotional Campaign to Improve Uptake of Intermittent Preventive Antimalarial Treatment in Pregnancy in Burkina Faso

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Abstract. Malaria preventive strategies in pregnancy were assessed in a health center randomized trial comparing intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) with and without community based promotional activities in rural Burkina Faso. The study involved 2,240 secundigravidae and secundigravidae and evaluated factors associated with antenatal clinic (ANC) attendance and uptake of IPTp-SP. With promotion, 64.2% completed ≥ 3 ANC visits compared with 44.7% without ($P = 0.05$). Complete uptake of IPTp-SP was 71.8% with and 49.1% without promotion ($P = 0.008$). The IPTp-SP uptake was lowest in adolescents delivering during high malaria transmission with (29%) or without promotion (30%). Uptake of SP was higher during the low transmission season than in the high transmission season (adjusted odds ratio = 2.17, 95% confidence interval = 1.59–3.03). Community sensitization increased ANC attendance and IPTp-SP uptake. Adolescents were the most difficult to reach, particularly during the high malaria transmission period. The impact of IPTp-SP will be limited unless this high risk group is protected.

INTRODUCTION

Malaria in pregnancy contributes substantially to maternal anemia and low birth weight (LBW) and effective malaria control in pregnancy will avoid approximately 10,000 maternal and up to 200,000 infant deaths every year.[1,2] Intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) administered at least twice during routine antenatal clinic (ANC) visits is recommended by the World Health Organization (WHO) for areas of moderate-to-high malaria transmission, which includes most of sub-Saharan Africa. Other components of the malaria control strategy include insecticide-treated bed nets and case management of clinical malaria and anemia.[3] The WHO recommends four scheduled antenatal visits starting in the first trimester, which provides the appropriate health contacts to implement malaria preventive interventions. Antenatal clinics are usually well implemented in many parts of Africa, although considerable disparities may occur at the local level depending on cultural and socioeconomic factors.[4]

Studies in Kenya and Malawi[5–7] have shown that two doses of IPTp-SP significantly reduced the prevalence of maternal anemia, placental malaria parasitemia, and incidence of LBW. Where IPTp-SP has been introduced as part of national policy, coverage has varied widely between countries with estimates of 33–93% for uptake of one dose and 24–68% for two doses. This low coverage has occurred despite good ANC attendance,[8] and no country has reached the current goal of 80% of pregnant women receiving at least two doses of IPTp-SP.[9,10] New approaches designed to improve IPTp-SP coverage are urgently needed.

The objective of this study was to evaluate the additional effect of a targeted promotional campaign on ANC use and on coverage and uptake of IPTp-SP in a rural health district in Burkina Faso.

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METHODS

Study site. The study was conducted during 2003–2006 in Les Balé Province in western Burkina Faso. In 2004, the estimated population of 204,117 was distributed in 133 villages and 37 hamlets and belonged to a variety of ethnic groups (Bwaba, Dafing, Ko, Nounouma, Mossi, Peulh, and others). Almost all practiced subsistence farming (sorghum, millet, maize, peanuts) and grew cotton for cash income. The climate is of a Sudano-Sahelian type with a rainy season during May–June through October (mean rainfall = 800 mm/year). Malaria is holoendemic with highly seasonal transmission during and after the rainy season.

Formal health services are provided by a district hospital situated in the provincial capital of Boromo and 27 peripheral health centers situated in larger villages up to 85 km from Boromo (Figure 1). Health centers are usually managed by two nurses and an auxiliary midwife who offer a minimum package of preventive and curative activities including outreach services in dependent villages. Antenatal services are free of charge since 2003 and comprise clinical examination, blood pressure measurement, tetanus toxoid vaccination, health counseling, and prescription of antimalarial and hematinic drugs. Women may have to pay fees for gloves, urine tests (200 FCFA = ≈0.40 US dollars), and curative drugs if appropriate. In 2003, health district statistics showed that 87% of expected pregnancies accessed ANC services at least once and 49% delivered in a health facility (Ouattara TF, unpublished data). Chloroquine (CQ) and SP were used as first-line and second-line drugs for treatment of uncomplicated malaria but because of increasing CQ resistance, in February 2005 the policy changed to artemisinin-based combination therapy for treatment of uncomplicated malaria and IPTp-SP for use in pregnancy.[11]

Study design and randomization. The study was designed as a cluster-randomized community-based effectiveness trial with health center as the cluster sampling unit. Primary outcomes were peripheral and placental parasitemia, anemia and birthweight, and secondary outcomes were number of ANC visits, timing of the first ANC visit, and total number of doses of IPTp-SP. Twelve peripheral health centers covering a total population

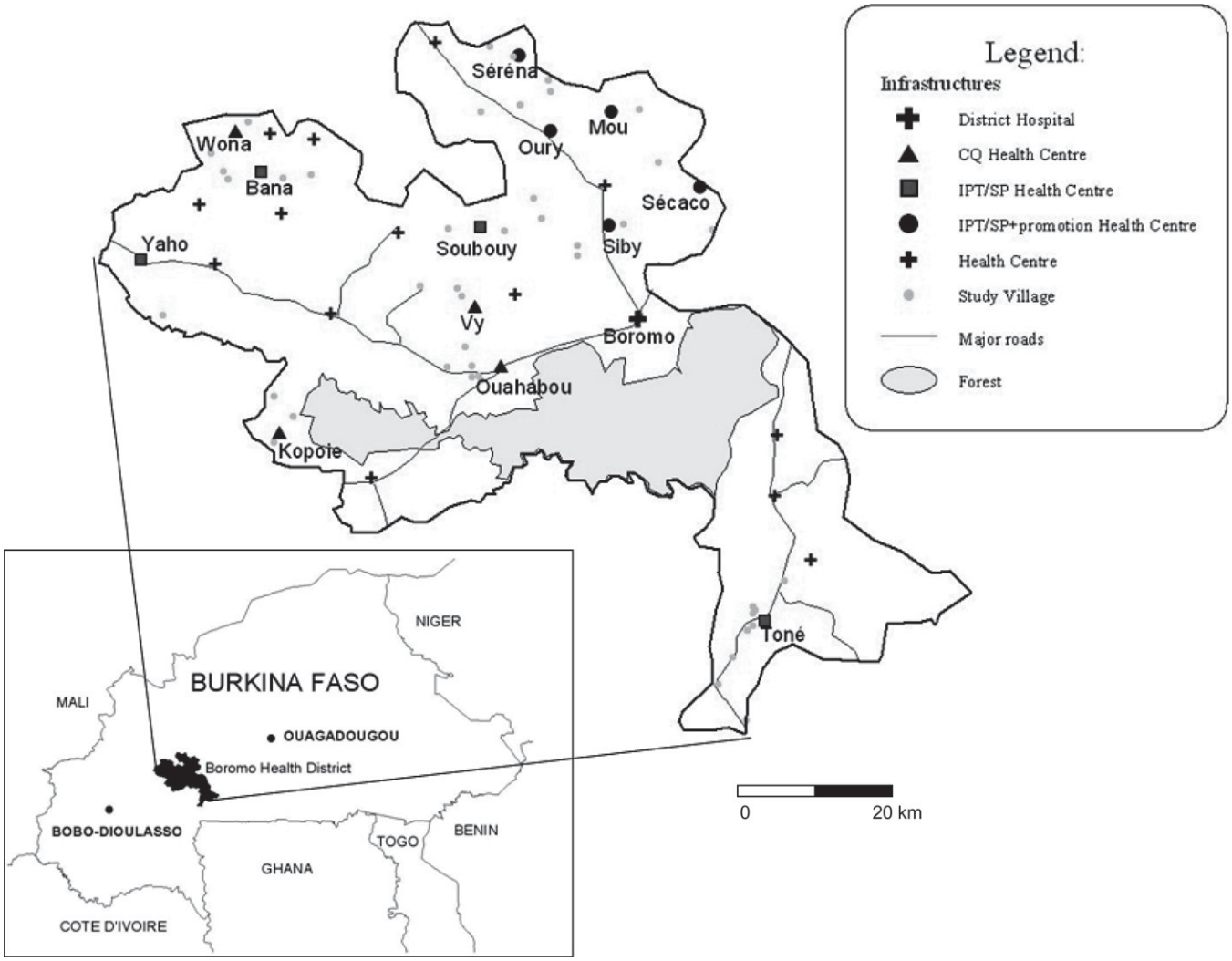

FIGURE 1. Study area and location of participating and non-participating health centers in Boromo Health District, Burkina Faso, 2004–2006.

of approximately 75,000 were assigned to one of three malaria prevention strategies: IPTp-SP plus promotion (Intervention A), IPTp-SP alone (Intervention B) or weekly CQ prophylaxis, which was national policy at the time the study began (control). To avoid contamination caused by spread of the promotional campaign across the study arms, four geographically contiguous health centers were selected for intervention A while other health centers were randomly assigned to intervention B and control arms (Figure 1).

For operational reasons and to obtain similar population sizes in all three study arms, health centers with a very small or large catchment population (< 2,500 or > 15,000) were excluded. A new health center (Mou) was opened during the study period (January 2005), which was within the catchment area of a health center receiving intervention A (Oury), which reduced for 2 villages the distance to the nearest health center from more than 10 km to less than 5 km. The revised distances have been taken into account in the analysis for deliveries occurring in these two villages. The potential of the promotional campaign to improve ANC attendance was evaluated by comparing the mean number of ANC visits, the proportion of women with at least three ANC visits, and the duration of gestation at the first ANC visit between study arms with (intervention A) and without promotion (intervention B and control combined). The effect on SP uptake was assessed by comparing the proportion of women receiving two or more doses of SP between IPTp-SP study arms with promotion (intervention A) and without promotion (intervention B).

Intervention. The intervention was implemented at two levels: the health center for drug delivery and the villages for the promotion campaign. In 8 health centers (intervention A and B), IPTp-SP was introduced in the ANC as part of the study and replaced the use of weekly CQ. A two-day training workshop for health care providers from participating health centers was conducted by one of the investigators (SG) and included an update on malaria prevention in pregnancy, the rational for IPTp-SP, and practical sessions for data collection (biological samples and study questionnaires). The ANC providers were advised to give two doses of SP at the beginning of both the second and third trimester of pregnancy. Each health center was given a plastic jug and goblet to provide drinking water for directly observed SP intake. The study team provided health centers with free SP tablets for all pregnant women attending ANCs.

In 2003, in preparation for the promotional campaign in intervention A area, a team of social scientists assessed local

knowledge, beliefs, and traditions related to malaria and pregnancy using qualitative methods (in depth interviews, focus group discussions, and key informant interviews). Subsequently, simple health messages based on these findings were formulated and translated into locally produced pictorial material to be used for sensitizing participating communities. This material was tested in the respective villages for adequate understanding and adapted to ensure clarity of the intended message. Two series of image boxes were produced, one about the content and benefit of ANCs including timing of visits and importance of IPTp-SP, the other about causes, signs, complications, and prevention of malaria in pregnancy. In addition, a poster illustrating the protective effect of SP on the health of mothers and their offspring was widely made available in the study area. In all 18 villages in the catchment areas of the four intervention A health centers, female leaders were selected as promoters from all sub-villages to cover the variety of local ethnic groups and languages between these villages. Two-day training courses for 63 promoters were conducted by the social scientist in central villages (with a health center) on all relevant aspects of ANCs and IPTp-SP, and on use of the image boxes, animation techniques for individuals, and group discussions. Subsequently, promoters organized (twice a month) sensitization sessions with groups of women according to a pre-defined schedule under the supervision of the social scientist.

To avoid conflicting messages between health centers and community promoters, study sensitization material was integrated into the routine health education sessions in health centers receiving intervention A. At the beginning of the intervention in May–June 2004, each of the four intervention A health centers organized a so-called health market, which was a day of general animation around health education in the village. Activities were organized by health workers and community members and included information stands on specific health topics (family planning, sexually transmitted diseases), blood pressure measurement, child growth monitoring, games, music and a *djandjo ba* (literally a great solemn dance), a popular women's dance. The overall aim of the health markets was to raise community awareness of the problems caused by malaria in pregnancy and to inform the population about the new treatment (IPTp-SP) pregnant women would receive at ANCs.

Data collection. Women in their first or second pregnancy were identified for follow-up at community level by nine locally recruited and trained women field assistants (WFAs) through monthly visits to all study villages. After obtaining oral informed consent, WFAs administered a questionnaire on demographic and household characteristics, education and socioeconomic status, obstetrical history, antenatal visits, illness, and treatment during the current pregnancy. Enrolled women received a card with a unique study number to be shown any time they attended a health center. Uterine symphyseal-fundal height was measured to confirm pregnancy, to estimate gestational duration, and to schedule a follow-up visit at approximately 32 weeks of gestation. At this follow-up visit, a finger prick blood sample was collected for a thick blood film and packed cell volume. Data on ANC visits and interim treatments were updated at each visit and cross-checked with health center data. Health staff at study health centers recorded clinical data (symptoms, body temperature) and information on prescribed drugs and observed SP intake on study questionnaires at any scheduled or unscheduled visit of a study participant and at delivery. Finger prick blood samples were collected before any antimalarial treatment. Whenever possible, maternal finger prick blood and a placenta sample were collected at delivery by health staff at health centers and at district hospital referrals. Women likely to deliver at home were visited weekly at the expected date of birth to record delivery data and birth weight as early as possible after delivery.

Definitions. Complete ANC attendance was ≥ 3 visits and complete IPTp-SP was ≥ 2 doses of SP. In view of the inaccuracy of symphyseal-fundal height measurements, gestational age at the first ANC visit was estimated using the time between the first ANC visit and delivery, assuming delivery occurred after 40 weeks gestation. Analyses including gestational age were restricted to normal deliveries of singleton live-births. Because of the uncertainty of gestational age, no attempt to define preterm delivery was made. Miscarriages and stillbirths were recorded as reported by participants or health staff. Socioeconomic status (SES) was assessed using a relative index based on building material of the house and roof and household assets (bicycle, motorbike, cart, car, television, radio, cell phone) and constructed using principal component analysis. Classes were derived by dividing the index into quartiles graded as most poor, poor, less poor, and least poor. Season was based on malaria transmission patterns; the low transmission season extended from January through June and the high transmission season extended from July to December.

Data analysis. Access 2003 was used for double data entry and validation and EpiInfo 2000 (version 3.2.2; Centers for Disease Control and Prevention, Atlanta, GA) and STATA (Intercooled version 10; Stata Corp., College Station, TX) software packages were used for analysis. Initially, villages were intended to be considered as the sampling unit. Because health centers were units of randomization, it was decided to account for the cluster design using linearized variance estimations with health center as the primary sampling unit (svyset HC, vce [linearized] in STATA version 10). Baseline characteristics were compared between study arms using a design-based Pearson chi-square test (svy linearized: tabulate in STATA version 10). We used linear regression models (svy linearized: regress) to compare means and logistic regression models (svy linearized: logistic) to compare proportions (≥ 3 ANC, ≥ 2 SP) and to determine odds ratios (ORs) with corresponding 95% confidence intervals (CIs). The criterion for statistical significance was set at alpha = 0.05. Variables tested as possible confounders were age (continuous and dichotomized ≤ 19/> 19 years), parity, education, marital status, husband's profession, SES, religion, season, and distance (continuous and dichotomized ≤ 5/> 5 km). Overall P values for ordinal variables with more than two categories were derived using linear combination (lincom in STATA). Variables associated with outcomes at a significance level of $P < 0.1$ in univariate analysis were entered in multiple logistic regression models and eliminated one by one if not significant ($P \geq 0.05$). Interactions between variables were assessed by creating product terms. Where appropriate, alternative models including a group variable with different levels for each possible combination between interacting variables were fitted. To assess the impact of the promotional campaign, promotion (intervention A) compared with non-promotion (intervention B and control combined) was kept as a variable in all models.

Sample size. The study was designed to detect at the 5% level and with 80% power a difference in mean birth weight

of 200 grams between study arms, accounting for the cluster (village) effect with a small coefficient of variation between clusters in each group. With 50 expected pregnancies per 1,000 inhabitants per year, one third first or second pregnancies, and allowing for 20% loss to follow-up, a total population of 70,000 was needed for inclusion and follow-up of 2,000 primigravidae and secundigravidae in two years. This sample size would be sufficient to detect differences in ANC coverage or SP uptake of 10% between study arms assuming that the percentage in the control arm was 50%.

Final sample. Women enrolled during the first months of the study were likely to have attended an ANC before the interventions were implemented and to have already received CQ chemoprophylaxis instead of IPTp-SP. The intervention A arm would not have been exposed to promotional activities. Therefore, women in their fourth or later month of pregnancy at the time the study started (delivery date before September 1, 2004) were excluded *a priori* from the analysis.

Ethical clearance. The study was reviewed and approved by the Burkina Faso Ministry of Health and the Ethical Committee at Prince Leopold Institute of Tropical Medicine, Antwerp. Local health authorities and community leaders were informed about the study objectives and procedures for data collection. All study participants gave oral informed consent after explanation of the procedures in the local language.

RESULTS

Study population. A total of 2,766 women in their first or second pregnancy was enrolled between April 2004 and April 2006; 208 (7.5%) were lost to follow-up, 8 (0.2%) withdrew consent, 262 (9.4%) delivered before September 2004 and were *a priori* excluded, 45 (1.6%) had a miscarriage, and 3 (0.1%) died during pregnancy, leaving 2,240 deliveries for this analysis (Figure 2). The median age was 19 years (range 14–41 years), with 18.9% younger than 18 years. Three of four primigravidae and one of four secundigravidae were adolescents (≤ 19 years of age). Women were often married to a farmer or breeder and had no formal education. Promotion and nonpromotion arms were similar for most characteristics but differed with ethnic group, women's income, husband's profession, and SES (Table 1).

Use patterns of antenatal services. Almost all women in the study area who had been followed-up until delivery attended an ANC at least once during pregnancy (96%, 2,154

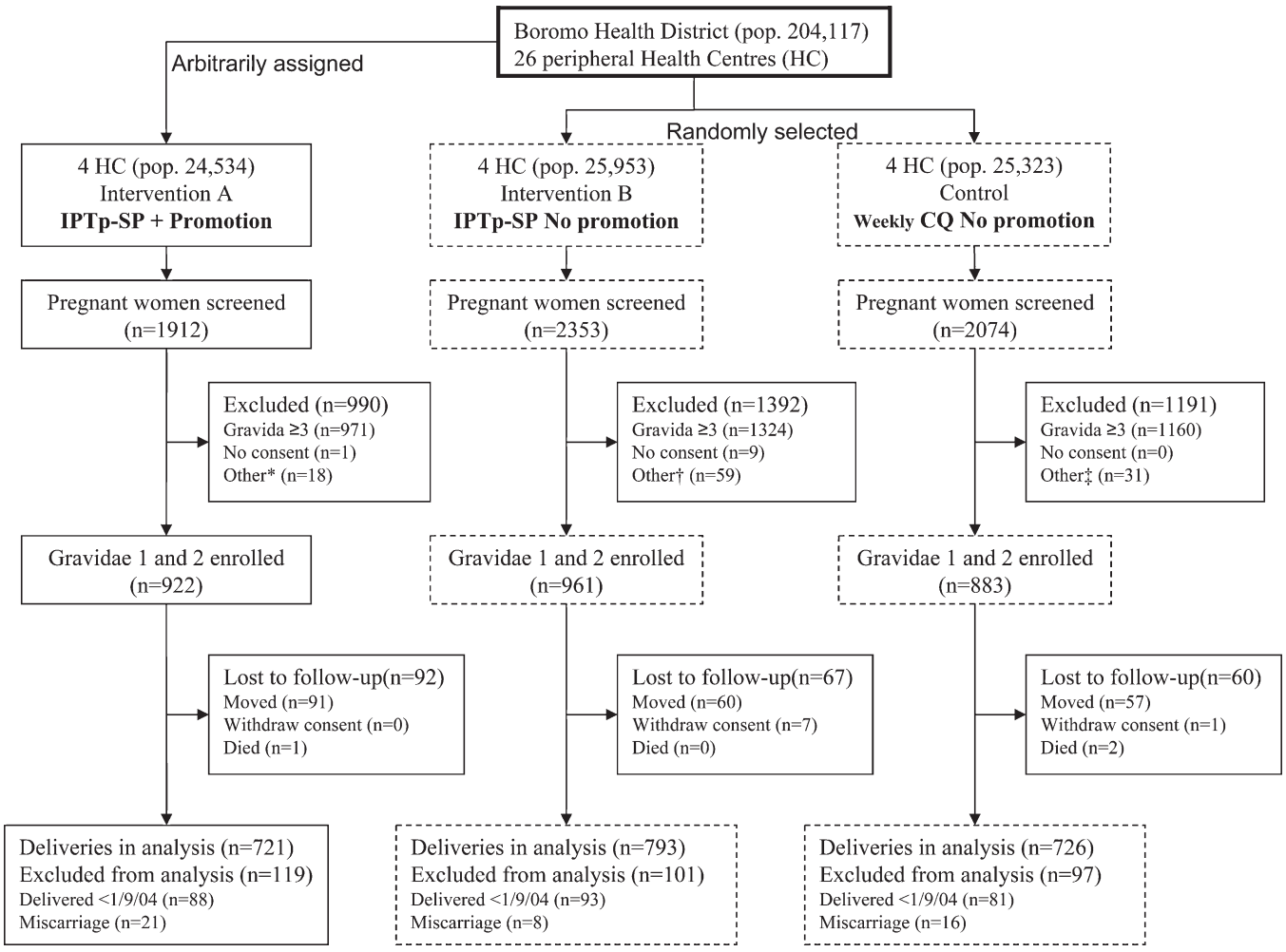

FIGURE 2. Study design and enrollment of study participants. Promotion arm = continuous line; non promotion arms = stippled line. * 18 near term in March–April 2004; † 3 not pregnant, 1 delivered before enrollment, 55 near term in March-April 2004; ‡ 2 not pregnant, 29 near term in March–April 2004.

TABLE 1
Characteristics of women enrolled in the study*

Characteristic	Promotion, % (n = 721)	No promotion, % (n = 1,519)	Total, % (n = 2,240)
Age, years†			
< 18	14.7	20.9	18.9
18–19	30.9	37.0	35.0
> 19	54.4	42.2	46.1
Primigravidae	56.5	54.5	55.1
Previous pregnancy outcome if secundigravida			
Miscarriage/stillbirth	15.6	11.6	12.9
Child death	13.1	18.4	16.7
Living child	71.3	70.0	70.5
Married	94.2	95.5	95.0
Ethnic group‡			
Bwaba/Dafing	13.2	73.6	54.2
Ko/Nounouma	60.6	6.6	24.0
Mossi	16.0	8.8	11.1
Peulh	5.4	5.7	5.6
Other	4.9	5.3	5.2
Religion§			
Moslem	57.6	43.4	47.9
Christian	22.5	17.6	19.2
Traditional	19.9	39.0	32.8
Mother's formal education¶			
None	75.0	80.5	78.8
Primary school (1–3 years)	5.7	5.1	5.3
Primary school (4–6 years)	15.5	11.6	12.9
Secondary and higher	3.8	2.7	3.0
Mother with own income‡#	53.1	77.5	69.7
Husband farmer or breeder‡	87.8	94.2	92.1
Socioeconomic status (quartiles)‡**			
Most poor	14.5	27.0	22.9
Poor	23.8	28.4	26.9
Less poor	19.8	27.8	25.2
Least poor	42.0	16.8	25.0
Distance from health center, km			
0–5	76.8	71.2	73.0
> 5	23.2	28.8	27.0

* Missing values for some characteristics explain slightly varying numbers.
† n = 2,239 (promotion = 721, no promotion = 1,518).
‡ Characteristic differing significantly ($P < 0.05$) between groups.
§ n = 2,238 (promotion = 719, no promotion = 1,519).
¶ n = 2232 (promotion = 721, no promotion = 1,511).
# n = 2,234 (promotion = 720, no promotion = 1,514).
** n = 2,213 (promotion = 719, no promotion = 1,498).

TABLE 2
Use of antenatal services and uptake of intermittent preventive treatment with sulfadoxine-pyrimethamine*

Use of ANC and IPTp-SP	Promotion, % (n) (n = 721)	No promotion, % (n) (n = 1,519)	*P*
Total no. of ANC visits			0.046
0	1.1 (8)	5.1 (78)	
1	9.6 (69)	19.6 (297)	
2	25.1 (181)	30.6 (465)	
3	38.1 (275)	28.5 (433)	
≥ 4	26.1 (188)	16.2 (246)	
Timing of first ANC visit†			0.006
1st trimester	12.2 (83)	8.5 (116)	
2nd trimester	69.1 (469)	61.9 (845)	
3rd trimester	18.7 (127)	29.6 (404)	
Total no. of IPTp-SP doses‡			0.002
0	2.1 (15)	9.2 (73)	
1	26.1 (188)	41.7 (331)	
2	67.8 (489)	48.1 (381)	
3	3.9 (28)	1.0 (8)	
4	0.1 (1)	(0)	

* ANC = antenatal clinic; IPTp-SP = intermittent preventive treatment with sulfadoxine-pyrimethamine.
† Gestational age was available only for 2,044 women with singleton life-births (promotion = 679, no promotion = 1,365).
‡ Includes only women in IPTp-SP study arms, n = 1,514 (promotion = 721, no promotion = 793).

of 2,240). Half of those who attended completed the national standard of three or more visits (53%, 1,142 of 2,154), and 20% (434 of 2.154) the WHO standard of four or more visits (Table 2). Complete ANC attendance (≥ 3 visits) was more frequent in the promotion arm (64.2%, 463 of 721) than in either of the non-promotion arms (intervention B = 42.8%, 339 of 793, control = 46.8%, 340 of 726). Mean gestational duration at the first ANC visit was 23.5 weeks (95% CI = 22.5–24.6), 9.7% (199 of 2,044) occurred during the first trimester and 26.0% (531 of 2,044) occurred during the third trimester. The proportion of women attending ANCs during the first trimester was higher (12.2%, 83 of 679) in the promotion than in the non-promotion area: 8.7% (61 of 699) in intervention B ($P = 0.030$) and 8.3% (55 of 666) in the control ($P = 0.185$). The proportion of women with at least 3 ANC visits was highest among those attending ANCs early in pregnancy (88.9%, 177 of 199) and lowest among those attending late (16.0%, 85 of 531).

Factors associated with regular ANC attendance are shown in Table 3. Attendance increased by 11% per year of age (OR = 1.11, 95% CI = 1.07–1.15, $P < 0.001$). Among adolescents, 46% (555 of 1,207) completed ≥ 3 ANC visits compared with 55.2% (487 of 883) of women 20–24 years of age and 67.1% (100 of 149) of women ≥ 25 years of age ($P < 0.001$). With increasing distance of residence from the health center, complete ANC attendance decreased by 9% per kilometer (OR = 0.91, 95% CI = 0.86–0.97, $P = 0.006$). More than half of the women (56.1%, 918 of 1,636) living within 5 km of a health center attended ≥ 3ANCs compared with 42.1% (184 of 437) of those living 6–9 km from a health center and 24% (40 of 167) of those living ≥ 10 km from a health center ($P = 0.005$). Women who delivered during the high transmission season were less likely to complete ≥ 3 ANC visits (45%) than women who delivered during the low transmission season (57%) ($P = 0.006$). Other factors associated with regular ANC attendance were higher SES ($P = 0.015$), the husband not being a farmer or breeder ($P = 0.02$), and Christian religion compared with Muslim or traditional faith ($P = 0.001$). Parity (OR = 0.93, 95% CI = 0.73–1.19), marital status (OR = 0.87, 95% CI = 0.69–1.10), and education (OR = 1.33, 95% CI = 0.85–2.06) were not associated with antenatal attendance. The type of malaria prevention offered at ANCs (IPTp-SP or weekly CQ) had no effect on frequency of attendance (OR = 1.28, 95% CI = 0.54–3.02).

Effect of the promotion on antenatal attendance. Women in the promotion area were more likely to attend an ANC during the first trimester (12% versus 9%) ($P = 0.050$) and less in the third trimester (19% versus 30%) ($P = 0.011$) (Table 2). Consequently, regular ANC attendance (≥ 3 ANC visits) was more frequent among women in the promotion arm (64%) than in the non-promotion arm (45%) ($P = 0.050$) (Table 3).

In the multivariate analysis, significant ($P \leq 0.050$) interactions between promotion and age of mother and season

TABLE 3
Factors associated with regular antenatal attendance in univariate analysis (n = 2,240)*

Characteristic	% ANC ≥ 3	(n/N)	OR (95% CI)	*P*
Intervention arm				
Promotion	64.2	(463/721)	2.22 (1.0–4.9)	0.050
No promotion	44.7	(679/1,519)	1	
Age, years				
≤ 19	46.0	(555/1,207)	0.65 (0.51–0.82)	0.002
> 19	56.9	(587/1,032)	1	
Husband's profession				
Other	60.8	(107/176)	1.53 (1.09–2.17)	0.020
Farmer/breeder	50.3	(1,035/2,058)	1	
Socioeconomic status				0.015
Most poor	49.8	(253/508)	0.62 (0.38–1.02)	
Poor	44.1	(263/597)	0.50 (0.31–0.80)	
Less poor	49.1	(274/558)	0.61 (0.41–0.90)	
Least poor	61.4	(340/554)	1	
Season of delivery				
High transmission	45.0	(493/1,095)	0.61 (0.45–0.84)	0.006
Low transmission	57.1	(648/1,134)	1	
Religion				
Christian	63.0	(271/430)	1.84 (1.39–2.44)	0.001
Muslim or Traditional	48.1	(869/1,808)	1	
Distance from nearest health center, km				
> 5	37.1	(224/604)	0.46 (0.26–0.83)	0.014
0–5	56.1	(918/1,636)	1	

*ANC = antenatal clinic; OR = odds ratio; CI = confidence interval.

of delivery were observed. We fitted a model that included a group variable, with different levels for each of the four possible age (≤ 19/> 19 years) and season of delivery (low or high transmission) combinations, and effects of promotion in each of the four groups in addition to effects for religion and distance to the nearest health center (Table 4).

The ANC visit rates were highest in adult women delivering in the low transmission season and lowest in adolescents delivering in the high transmission season ($P < 0.001$). Adult women delivering in the high transmission season and adolescents delivering in the low transmission season had an intermediate ANC visit rate; the difference with adult women delivering in the low transmission season was not significant. Promotion increased ANC attendance in all groups apart from adolescents delivering in the high transmission season.

Relation between ANC attendance and SP uptake. The number of SP doses a woman had received throughout pregnancy was strongly related to the number of ANC visits completed by the time of delivery. Among 1,514 women in the IPTp-SP study arms, 519 had received one dose of SP (34%), 870 had received two doses (57%), 36 had received three doses (3%), and 88 had received no doses (6%). Figure 3 shows coverage with IPTp-SP in relation to total number of ANC visits. Most women with only one ANC visit received one dose of SP (95%). The coverage with two or more doses of SP was 46% with two ANC visits, and increased to 83% after three visits, and to 97% after four or more visits. Among women with ≥ 3 ANC visits, the proportion of those with complete SP uptake was higher in the promotion area (88.4%) than in the non-promotion area (76.2%) ($P = 0.009$).

Effect of the promotion on IPTp-SP uptake. In the promotion villages, 71.8% of women received at least 2 doses of SP by the time they delivered compared with 49.1% in the non-promotion villages ($P = 0.008$). Factors associated with complete SP uptake were similar to those associated with regular ANC attendance (Table 5). Primigravidae were less likely to receive ≥ 2 doses of SP than secundigravidae ($P = 0.002$) although this difference was not significant when adjusted for covariables.

In the multivariate analysis, an age ≤ 19 years, lower SES, non-Christian religion, distance > 5 km from a health center, and delivery during the high transmission season were independent risk factors for non-uptake of ≥ 2 SP doses. No significant interactions were observed. To identify high risk groups, the effect of the promotion was also assessed in sub-groups combining age (≤ 19/> 19 years), season of delivery (low and high transmission), and distance (≤ 5/> 5 km). The results are shown in Figure 4. The lowest coverage with IPTp-SP (≥ 2 doses) was in adolescents delivering during the high transmission season and living more than 5 km from a health center in the promotion (29%) and non-promotion (30%) arms. In adults, at equal distance and during the high transmission season, SP coverage was similar in the non-promotion arm (29%) and doubled in the promotion arm (58%) although this difference was not significant ($P = 0.152$). The effect of the promotion was greatest during the low transmission season for adults and adolescents and overcame the effect of distance.

DISCUSSION

Community-based promotional activities in this rural west African setting resulted in an increased use of antenatal services and uptake of IPTp-SP by primigravidae and secundigravidae. In promotion villages, pregnant women attended ANCs on average two weeks earlier than in non-promotion villages and consequently were more likely to have had at least three ANC visits (64% versus 45%) and two or more doses of IPTp-SP (72% versus 49%). Maternal age, season of delivery, and distance of residence from the health center were identified as the main predictors for complete ANC attendance and IPTp-SP uptake. Interestingly, age and

TABLE 4
Regular antenatal clinic attendance (≥ 3 visits) in multivariate analysis (n = 2,226)*

Characteristic	AOR (95% CI)	*P*
Effect of group on regular ANC visit†		
Age ≤ 19 years/high transmission	0.59 (0.47–0.74)	< 0.001
Age ≤ 19 years/low transmission	0.88 (0.67–1.16)	0.328
Age > 19 years/high transmission	0.74 (0.52–1.04)	0.076
Age > 19 yearst/low transmission	1	
Effect of promotion on ANC visit by group‡		
Age ≤ 19 years/high transmission	1.16 (0.57–2.34)	0.662
Age ≤ 19 years/low transmission	2.70 (1.30–5.62)	0.012
Age > 19 years/high transmission	2.23 (0.86–5.76)	0.091
Age > 19 years/low transmission	3.06 (1.29–7.23)	0.016
Religion		
Christian	1.64 (1.29–2.08)	0.001
Muslim or Traditional	1	
Distance from nearest health center, km		
> 5	0.49 (0.27–0.87)	0.019
0–5	1	

*ANC = antenatal clinic; AOR = adjusted odds ratio; CI = confidence interval.
†Group variable with four levels for all possible combinations of age (≤ 19/> 19 years) and season of delivery (dry/rainy). Reference is adults delivering in the low transmission season.
‡Comparing promotion versus no promotion within each level of the group variable (age/season).

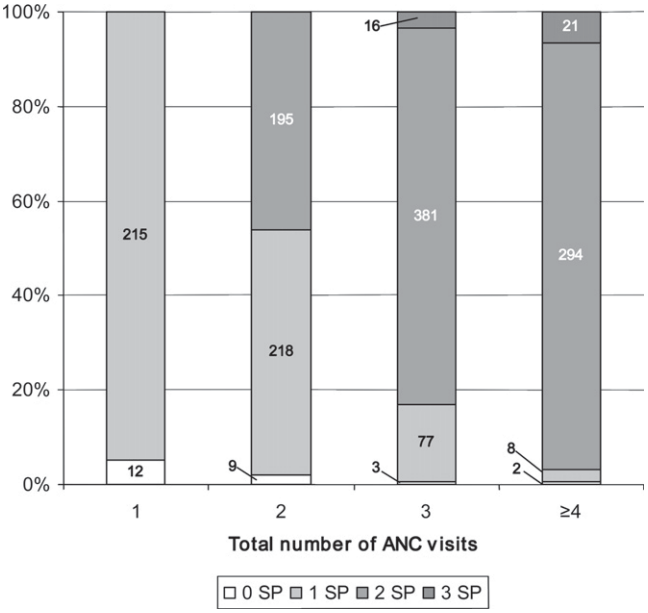

FIGURE 3. Number of intermittent preventive treatment with sulfadoxine-pyrimethamine (SP) doses by total number of antenatal clinic (ANC) visits in primigravidae and secundigravidae (n = 1,451) attending an ANC at least once. Numbers in bars represent numbers of women.

season interact with promotion, and both modify the effect of the promotion on completion of ANC attendance. Promotion activities were associated with a more than two-fold increase of complete ANC attendance in women who delivered during the low transmission season for adults and adolescents. For deliveries during the high transmission season, the effect of the promotion was borderline in adults and absent in adolescents. Consequently, the uptake of IPTp-SP was lowest in adolescent mothers who delivered during the high transmission season and did not differ between promotion and non-promotion areas. A similar effect of age on SP uptake has been reported from Kenya.[12]

Although parity and age are closely correlated, access to ANCs and effect of promotion were determined by age and not parity in this study. The study population was purposely restricted to first and second pregnancies because of their increased risk of malaria and was thus generally young, although even among adolescents most were married. To reach a health center for antenatal care and to attend educational sessions (promotion), pregnant women have to leave their household duties. In rural Burkina Faso, a woman's mobility largely depends on her social status within the family, which increases with the numbers of years she has proven to be a good worker, respecting her husband and in-laws.[13] Movement of girls and young women in villages are closely supervised and limited to traditional spaces such as water wells, places of worship, and market places. For any activity outside the traditional space, they should obtain permission from their husband or his representative.[14] Such restrictions make pregnant adolescents in rural areas a group particularly difficult to reach for health interventions such as educational group discussions or ANCs.

The limited access to ANC services adolescents have is most striking for those who deliver during the second compared with the first half of the year. This division of the year is primarily based on local patterns of malaria transmission but equally applies to most farming activities, concentrated in the second half and followed by a period of relative rest during the first months of the year. Finding time for an ANC visit becomes more difficult when the workload is high. Access may be further decreased by temporarily impassable roads during the rainy season. For the same reason, health staff may reduce outreach activities in distant villages. Distance, measured either in kilometers or in travel time, has been mentioned as a factor determining use of antenatal services.[15–18] However, there is no record on how season affects ANC coverage. In this study population, ANC coverage and IPTp-SP uptake were consistently lower during the second half of the year with limited impact of promotional activities, resulting in a substantial proportion of pregnant women, adolescents in particular, not benefiting from IPTp-SP at the time when they most needed it, during the high malaria transmission period.

The overall coverage with at least two doses of SP was 60% in the two IPTp-SP study arms even though most women (80%) had visited an ANC two or more times. The first dose of SP was generally given at the first ANC visit and most women with just one ANC visit had received one dose of SP. Reasons for missed dosing include client-related (e.g., late ANC attendance) or facility related factors, the latter including confusion of health workers about correct timing and spacing of SP doses, and restriction of SP early in pregnancy or difficulties in correctly assessing gestational age.[7,19–21] In this study, two-thirds of incomplete IPTp-SP-dosage could be attributed to insufficient or late ANC attendance, with the

TABLE 5
Factors associated with complete IPTp-SP uptake (≥ 2 doses) in univariate and multivariate analysis*

Characteristic	% ≥ 2 SP	(n/N)	Univariate analysis (n = 1,514) OR (95% CI)	*P*	Multivariable analysis (n = 1,490) AOR (95% CI)	*P*
Intervention arm						
Promotion	71.8	(518/721)	2.65 (1.36–5.18)	0.008	2.22 (1.41–3.50)	0.003
No promotion	49.1	(389/793)	1		1	
Age, years						
≤ 19	54.5	(440/808)	0.61 (0.48–0.78)	0.001	0.75 (0.58–0.98)	0.035
> 19	66.2	(467/705)	1		1	
Gravidity						
Primigravida	56.5	(480/849)	0.73 (0.61–0.87)	0.002		NS
Secundigravida	64.2	(427/665)	1			
Mother's formal education						
Any school	66.4	(217/327)	1.43 (0.93–2.18)	0.093		NS
None	58.1	(690/1,187)	1			
Husband's profession						
Other	68.2	(88/129)	1.47 (1.07–20.3)	0.021		NS
Farmer/breeder	59.3	(818/1,380)	1			
Socioeconomic status				0.06		0.008
Most poor	55.7	(157/282)	0.54 (0.31–0.95)		0.72 (0.54–0.97)	
Poor	52.6	(190/361)	0.48 (0.29–0.79)		0.59 (0.43–0.81)	
Less poor	58.8	(234/398)	0.62 (0.45–0.85)		0.88 (0.67–1.14)	
Least poor	69.8	(319/457)	1		1	
Season of delivery						
High transmission	52.2	(391/749)	0.52 (0.37–0.73)	0.001	0.46 (0.33–0.63)	< 0.001
Low transmission	67.8	(515/760)	1		1	
Religion				0.024		
Christian	69.6	(204/293)	1.85 (1.24–2.77)		1.47 (1.09–1.98)	0.015
Muslim or Traditional	57.5	(701/1,219)	1		1	
Distance from nearest health center, km						
> 5	43.3	(205/473)	0.37 (0.23–0.60)	0.001	0.43 (0.26–0.72)	0.004
0–5	67.4	(702/1,041)	1		1	

*IPTp-SP = intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine; OR = odds ratio; CI = confidence interval; AOR = adjusted odds ratio; NS = not significant ($P \geq 0.05$).

remaining third not having received SP during ANC visits. A program evaluation in Koupéla District recommending three doses of IPTp-SP achieved a coverage with ≥ 2 doses of 78.6% among 1,188 women delivering in two health centers.[22] This supports suggestions that giving SP at every routinely scheduled ANC visit after quickening would be more effective in ensuring at least two doses.[3,23,24] In this study population, few women attended ANCs too early to receive the first dose of IPTp-SP at the first visit. Because intervals between ANC visits were generally greater than one month, this simplified approach (one dose of SP at every ANC visit after the first trimester) would have been safe and could have achieved a substantially higher coverage with IPTp-SP.

The promotional campaign in this study was initially designed to reach all women of reproductive age (15–45 years) and the communities as a whole. To assess the effectiveness of IPTp-SP on pregnancy outcomes, only women in their first and second pregnancy, the group known to bear the highest burden of malaria in pregnancy,[25] were followed-up. However, even within this risk group, primigravidae, who were predominantly adolescents, had higher infection rates and experienced greater benefits from complete IPTp-SP in terms of reduction of anemia and birthweight gains (Gies S, unpublished data). This group was the one most difficult to reach through the promotional campaign. Earlier identification of adolescents as a specific risk group and of the geographic and social barriers preventing them from seeking antenatal care in a timely manner could have lead to an adaptation of the promotional activities to the specific needs of young, newly married women.[14,26] A possible way to improve the effectiveness of IPTp-SP could be the extension of promotional activities specifically addressing the needs of married adolescents to the whole community, including husbands and mothers-in-law. Young married adolescents are also at high risk of other health problems such as sexually transmitted diseases, human immunodeficiency virus, and domestic violence, and not least because they are often less educated. It is therefore important to find ways to address a number of these needs through education or community based programs.[27,28]

For periods of reduced accessibility of ANCs, alternative approaches for administering IPTp-SP, e.g., through traditional birth attendants or other community members linked to the health center, could be considered. Community health workers have successfully been involved in home-based treatment of uncomplicated malaria in children in Burkina Faso[29,30] and could possibly play a role in the delivery of IPTp-SP. To reach the high risk group of married adolescents, other community members may be more eligible, for instance mother-educators trained to reach married adolescents in their homes and support them during their first pregnancy.[26] However, the use of different drugs for children and pregnant women may lead to confusion in the community. Recent experiences in Uganda and Malawi suggest that community approaches could substantially improve IPTp-SP uptake in adult pregnant women,[31,32] although this must be achieved without reducing motivation to attend ANCs.

Measuring behavioral changes and their determinants is not a simple task and several limitations may be considered

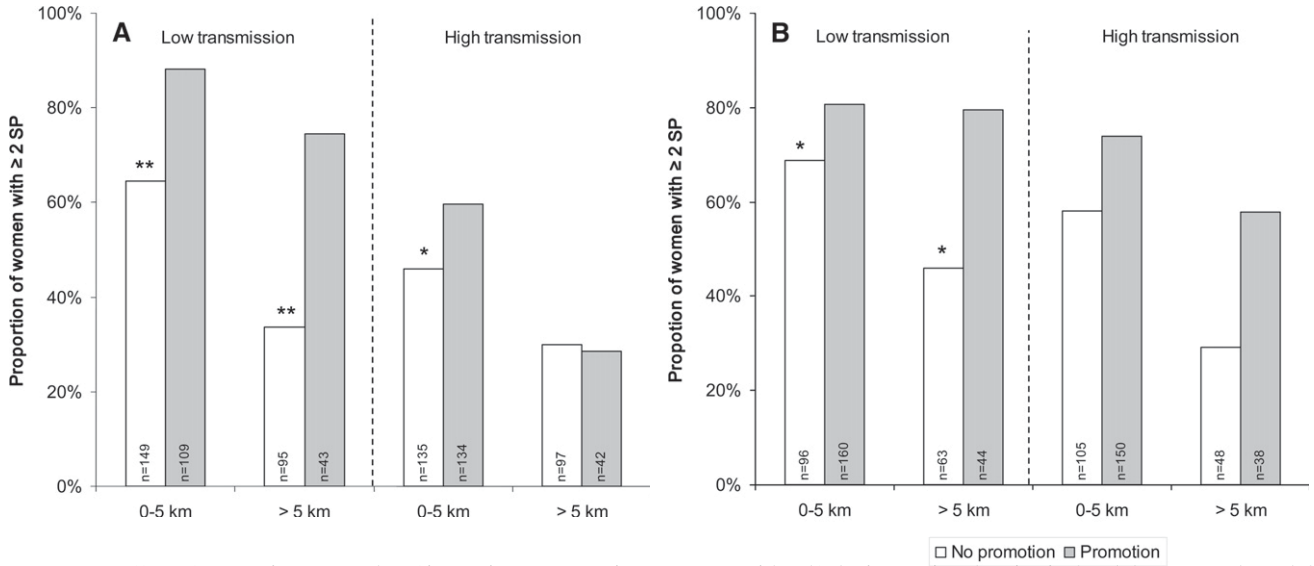

FIGURE 4. Effect of promotion on uptake of intermittent preventive treatment with sulfadoxine-pyrimethamine in **A**, adolescents and **B**, adults. * $P \leq 0.05$; ** $P \leq 0.001$.

for this study. Even without an intervention, use of health services varies within a region between health centers and within the same health center between villages. The relative small number of health center clusters in this study could be a limitation, although this feature has been taken into account in the analysis. The population structure of the district and the selection process of the intervention and control areas resulted in some differences in sociocultural and economic characteristics between groups, which may have influenced the results beyond any statistically possible adjustment, a further limitation. Women's access to health care may differ between groups, e.g., with rather liberal (Bwaba) or restrictive gender relationships (Mossi).[13] This would have reduced the differences between intervention arms because Mossi lived mainly in the promotion arm.

The follow-up of pregnant women was organized taking care of not interfering with the women's decision of attending the ANC. Women field assistants, selected with the agreement of community representatives, scheduled only two follow-up visits at home and health center data were recorded independently by health staff during ANC visits. Although implementation of the study may have raised community awareness about malaria in pregnancy and influenced health center use, this would have occurred similarly in all study arms. Health district statistics indicate that in 2005 overall ANC attendance (number of ANC booking visits/number of expected pregnancies) was slightly higher in study health centers (100%) than in health centers not involved in the study (95%). The difficulties of assessing gestational age under field conditions are well known[19] and probably several errors occurred in this study. However, this should have occurred equally across the three study arms.

In conclusion, raising community awareness about the risks of malaria in pregnancy and the benefits of ANCs and malaria preventive measures can substantially increase ANC attendance and IPTp-SP uptake in a rural community. Adolescent mothers are the most difficult to reach, particularly during the high malaria transmission season. Specific approaches designed to reach this high risk group are urgently needed. Intermittent preventive treatment with sulfadoxine-pyrimethamine will not be able to have a major impact on malaria in pregnancy unless this high risk group is protected.

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