BMC Public Health

Antenatal visits are positively associated with uptake of tetanus toxoid and intermittent preventive treatment in pregnancy in Ivory Coast

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Abstract

Background: Malaria and tetanus infections among pregnant women represent two major public health problems in sub-Saharan Africa. Optimum use of Intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine-pyrimethamine (IPTp-SP) and immunization against tetanus among pregnant women during antenatal care (ANC) visits are recommended strategies to prevent these issues. Despite these recommendations, many women in Africa remain deprived of these cost-effective and life-saving interventions. In this study, we aimed to examine the prevalence of women using these two services, and the association between women's uptake of IPTp-SP and tetanus toxoid (TT) with antenatal care use in Ivory Coast.

Methods: This study was based on the fifth round of Multiple Indicator Cluster Survey (MICS 5) conducted in Ivory Coast in 2016. Participants were 9583 women aged between 15 and 49 years. Outcomes were TT and Intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP). Data analysis was conducted using bivariate and multiple logistic regression.

Results: In this study, the prevalence of taking TT immunization and IPTp-SP drugs was 81.97 and 17.83% respectively. Of the participants who took these drugs at all, the prevalence of taking adequate doses of TT immunization was 78.75% and that of IPTp-SP was 35.46%. In the multivariable analysis model, higher age groups, 25–29 years (OR = 2.028, 95%CI = 1.120–3.669) were found to be positively associated with uptake of adequate doses of IPTp-SP drugs. Women who attended at least four ANC visits had higher odds of taking IPTp-SP drugs (OR = 1.656, 95%CI = 1.194–2.299) and TT immunization (OR = 2.347, 95%CI = 1.384–3.981), and also had higher odds of receiving adequate doses of IPTp-SP drugs (OR = 3.291, 95%CI = 2.157–5.020) and that of TT immunization (OR = 1.968, 95%CI = 1.398–2.771). The odds of taking IPTp-SP drugs were significantly higher among women with primary (OR = 2.504, 95%CI = 1.020–6.146) and secondary/higher education (OR = 3.298, 95%CI = 1.343–8.097) compared to those with no education. Also, women with higher parity had lower odds of taking TT immunization (OR = 0.218, 95%CI = 0.055–0.858) compared to those with lower parity. Findings from this study also revealed that the odds of taking adequate doses of IPTp-SP drugs were significantly lower among participants from Mandé du Nord ethnicity (OR = 0.378,95%CI = 0.145–0.983) compared to those from other ethnicities.

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Conclusion: In this study, uptake of IPTp-SP drugs was much lower than TT immunization. High number of ANC visits were found to be significantly associated with taking IPTp-SP drugs and TT immunization and also with that of taking them in adequate doses. Vaccination promotion is necessary to protect pregnant women and reduce adverse health outcomes among the newborn in Ivory Coast.

Keywords: TT immunization, IPTp-SP drugs, Pregnant women, ANC visits, Ivory Coast

Background

Tetanus and Malaria in pregnancy are a major public health problem causing maternal, fetal and infant morbidity and mortality especially in sub-Saharan Africa [1–4]. Human Malaria is caused by five different species of Plasmodium: *P. falciparum*, P. malariae, *P. ovale* and *P. vivax*, and transmitted to people though the bites of infected female Anopheles mosquitoes [5, 6] . In 2017, WHO estimated 219 million cases of malaria in 90 countries and 435,000 deaths related to malaria. The sub-Saharan African region has been reported to carry the highest proportion of the global malaria burden; accounting for 92% of all malaria cases and 93% of malaria deaths [7].

To prevent and reduce malaria transmission, two forms of vector control are recommended by WHO; sleeping under insecticide-treated bednets (ITNs) [8–10] and indoor residual spraying with insecticides [11–13]. Besides this, environmental management practices – clearing bushes and draining stagnant water around houses also provide a form of prevention [14–16]. To prevent malaria in pregnant women living in areas of moderate and high malaria transmission especially in Africa, intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine pyrimethamine is recommended by WHO [17, 18]. Among 23 African countries surveyed on IPTp coverage levels in 2016, an estimated 19% of eligible pregnant women reported receiving the recommended 3 or more doses of IPTp, compared with 18% in 2015 and 13% in 2014 [19].

While some major progress has been made, the burden of malaria is still high in sub-Saharan Africa where an estimated 30 million pregnant women are at risk of contracting the infection yearly [17, 20]. In one of these countries (Ivory Coast), malaria infection in pregnant women has been reported to be the primary cause of anemia and fetal growth retardation, miscarriages, stillbirth as well as acute illness, pregnancy loss or preterm delivery, and early neonatal mortality [21–23].

With regards to maternal and neonatal tetanus (MNT), it is caused by a potent neurotoxin that is produced by *clostridium tetani*, a common toxic bacterium in soil and in animal intestinal tracts [24]. Tetanus is characterized by painful muscle spasms, serious complications, and can eventually lead to death [25]. Neonatal tetanus (NT) is particularly common and serious in rural

areas where most deliveries take place under unhygienic conditions at home where sub-standard prenatal and postnatal care for childbirth prevail. Most of the infected infants do not survive or experience seriously debilitating outcomes. In 2013, WHO estimated about 49,000 neonatal deaths were caused by NT alone [26]. Besides neonates, people of all ages can get tetanus, but it can be prevented by the administration of tetanus toxoid (TT), which induces specific antibodies. To prevent maternal and neonatal tetanus (MNT), TT immunization needs to be given to the mother before or during pregnancy, while also ensuring clean delivery and good cord care practices [27, 28]. Some studies have reported that the uptake of IPTp-SP and TT immunization are associated with women's level of education, age, residency, wealth index, parity, mass media use and distances from women's home to health facilities [29, 30]. Also, it has been reported that antenatal care (ANC) visits increases the uptake of IPTp-SP and TT immunization [31–34]. However, in Ivory Coast the proportion of women who take up IPTp-SP and TT while seeking ANC services and the factors associated with this is not known. The objective of this study therefore was to determine the proportion of pregnant women who use IPTp-SP and TT immunization, and the association between women's uptake of IPTp-SP and TT immunization with antenatal care use in Ivory Coast.

Methods

Data source

Data were collected from the fifth round of the Multiple Indicator Cluster Survey (MICS) for Ivory Coast, which was conducted in 2016. The Fifth Multiple Indicator Cluster Survey (MICS 5) in Ivory Coast was initiated by the Ministry of Planning and Development and executed in 2016 by the National Institute of Statistics (INS), as part of the global program for MICS surveys that have been developed by UNICEF since 1990 as an international household survey program. This program aims to support countries in collecting internationally comparable data across a wide range of indicators. Among other things, the MICS 5 Survey provides: (i) recent and detailed information for assessment of the situation of children and women in Ivory Coast; (ii) basic data to evaluate the progress towards the Millennium Development Goals

(MDGs), follow the Sustainable Development Goals (SDGs) and National Development Office (PND) 2016–2020. The main objective of the survey was to generate quality data on maternal and child health to facilitate evidence-based policy making, program monitoring towards the Sustainable Development Goals. In this survey 12,463 women were selected from 512 clusters (about 25 households per cluster), of whom 11,780 were interviewed (Response rate 94.5%). Details of the survey have been published elsewhere [35].

Outcome variables

The outcome variables in this study are similar to the one used in our previous study [30], namely "adequate use of Tetanus toxoid (TT)" and "intermittent preventive therapy with sulfadoxine-pyrimethamine (IPTp-SP)". These variables were measured by asking the respondents whether or not they received 1) TT vaccination and 2) Fansidar (sulfadoxine-pyrimethamine, SP) during their last pregnancy. According to WHO recommendations, at least three doses of TT (> 2 doses) was defined as adequate and < 2 doses, inadequate. For IPTp-SP, at least three (≥3 doses) doses were defined as adequate while less than three doses (< 3 doses) were considered inadequate.

Control variables

The following variables were considered for controlling the analysis due to their known /theoretical association with utilization of TT vaccination in the general population:

Age groups (15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49); Residency (Urban, Rural); Region (North, South, West); Education (Pre-Primary/ None, Primary, Lower Secondary, Upper Secondary/higher); Ethnicity (Akan Mandé Du Nord, Gur Ethnic, Non-Ivorian, Other); Wealth status (Poorest, Second, Middle, Fourth, Richest) [36]; Parity (1/2, 3/4, > 4); Radio use (Not At All, Less Than Once A Week, Almost Every Day); TV use (Not At All, Less Than Once A Week, Almost Every Day); Internet use (Yes, No); ANC visit (less than four/ Inadequate, > 4/Adequate).

Statistical analyses

Data analysis was performed using Stata version 14. Prevalence rates of taking TT vaccination and IPTp-SP for each explanatory variable were shown as percentages by using the survey command to account for survey weights. In the next step, we performed binary logistic regression modes to calculate the odds ratios of the associations between taking TT vaccinations, IPTp-SP and the covariates. Chi-squared bivariate tests and binary logistic regression analyses were used to examine the association. Variables that showed significant association in the bivariate tests were used for the multivariate analysis.

For multivariate analyses, separate analyses were performed for rural and urban sample along with the pooled analysis. We did additional tests by including interactions terms such as wealth#education and education#ANC. No significant interactions were observed in the total or stratified (urban /rural) models (results not shown). Statistical significance was set at *p*-value of < 0.05 for all analyses.

Results

A total of 9583 pregnant women aged 15–49 years were included in this study. Out of this, 81.97% received TT immunization, 78.75%received at least two doses of TT immunization, 17.83% received IPTp-SP drug and 35.46% received at least three doses of IPTp-SP drug. The proportion of TT immunization was 27% among women aged 25–29 years, 69.6% were residing in rural areas (69.6%), 62.7% among women with no formal education, 25.9% among participants from the Akan ethnicity, 27.3% among women from households with the poorest wealth quintile, 43.7% among those who have given birth at least once. Among women who did not use newspaper, radio and TV, the proportion of TT immunization was 71.3, 63.2, and 47.6% respectively. More than half (53.8%) of the women who received TT immunization had had at least three ANC visits.

Higher proportions of women who took at least two doses of TT immunization were observed among women aged 20–24 years (26.5%), women who lived in the rural areas (69.6%), those who had never attended any formal education (60.9%), and participants who belonged to the Akan ethnic group (27.7%). The results of this study also show that the percentage of women who took at least two doses of TT immunization was higher among pregnant women with the poorest households wealth (24.9%), those who had delivered at least once (46.6%), those who did not use newspaper (72.1%), radio (62.1%) nor watched TV almost every day (49.9%), and those who attended at least three ANC visits (60.2%).

In this study, most women using IPTp-SP drugs were in the age group of 25–29 years (28.2%), women who lived in rural areas (69.8%), those who had no formal education (61.7%), participants from the Akan ethnicity (28.7%), those from households with the poorest wealth quintile (27.9%) and women who had delivered at least once (42.4%). It also shows that the proportion of taking IPTp-SP drugs was higher among participants who did not use newspaper (71.1%) and radio (64.2%), watched TV almost every day (47.4%), as well as women who attended at least three ANC visits (53.2%).

Table 1 shows that uptake of three doses of IPTp-SP drugs was higher among participants aged 25–29 years (28.4%), those who lived in rural areas (66.2%), had no formal education (56.3%), women who belonged to the

Table 1 Sample characteristics (*n* = 9583)

	Took TT		Two doses of TT		IPTp-SP		Three doses of IPTP-SP drug	
	Yes (81.97%)	No (18.03%)	Yes (78.75%)	No (21.25%)	Yes (17.83%)	No (82.17%)	Yes (35.46%)	No (64.54%)
Age groups (years)								
15–19	11.8	9.0	12.2	11.8	11.5	21.0	10.7	12.0
20–24	25.0	22.0	26.5	25.0	23.4	17.3	23.5	23.3
25–29	27.0	27.1	26.2	27.0	28.2	16.4	28.4	28.1
30–34	20.5	21.1	20.7	20.5	20.5	15.1	22.0	19.7
35–39	11.2	12.8	10.1	11.2	11.7	12.9	10.9	12.1
40–44	3.9	6.7	3.9	3.9	3.8	10.1	4.1	3.7
45–49	0.6	1.4	0.3	0.6	0.9	7.3	0.5	1.2
p-value	0.002		.003		<.001		.105	
Residency								
Urban	30.4	15.5	30.4	37.5	30.2	42.3	33.8	30.2
Rural	69.6	84.5	69.6	62.5	69.8	57.7	66.2	69.8
p-value	<.001		.103		<.001		.004	
Education								
None	62.7	79.5	60.9	57.0	61.7	54.6	56.3	61.8
Primary	23.1	16.0	24.1	26.3	23.5	21.6	24.4	23.5
Secondary/ Higher	14.2	4.6	15.0	16.7	14.7	23.8	19.3	
p-value	<.001		.021		.170		<.001	
Ethnicity								
Other	12.6	7.6	12.2	12.6	12.6	12.4	12.1	12.6
Akan	25.9	16.7	27.7	25.9	28.7	29.8	32.7	28.7
Mandé Du Nord	16.8	15.4	16.8	16.8	13.2	17.5	11.9	13.2
Gur	19.5	36.5	18.9	19.5	21.1	19.1	20.9	21.1
Non-Ivorian	25.2	23.9	24.3	25.1	24.5	21.2	22.3	24.5
p-value	<.001		.046		<.001		.026	
Wealth index								
Poorest	27.3	46.0	24.9	27.3	27.9	19.7	23.6	27.9
Poorer	24.5	28.1	24.2	24.5	25.0	19.5	22.0	25.0
Middle	22.6	15.4	23.7	22.6	22.3	19.6	24.1	22.3
Richer	15.3	6.7	17.0	15.3	15.1	17.2	18.7	15.1
Richest	10.3	3.8	10.1	10.4	9.8	24.0	11.7	9.8
p-value	<.001		.001		<.001		<.001	
Parity								
1/2	43.7	12.2	46.6	11.8	42.4	26.8	45.7	41.9
3/4	30.5	13.3	29.4	17.0	30.8	12.3	28.4	30.7
> 4	25.8	74.4	23.9	71.3	26.7	60.9	25.9	27.4
p-value	<.001		<.001		<.001		.060	
Newspaper								
Almost Everyday	11.8	16.3	11.3	25.5	12.3	16.3	10.6	12.3
Few days a week	17.0	8.1	16.6	11.4	16.6	20.2	14.4	16.6
Never	71.3	75.7	72.1	63.2	71.1	63.5	75.0	71.1
p-value	.159		.114		.050		.105	

Table 1 Sample characteristics (*n* = 9583) *(Continued)*

	Took TT		Two doses of TT		IPTp-SP		Three doses of IPTP-SP drug	
	Yes (81.97%)	No (18.03%)	Yes (78.75%)	No (21.25%)	Yes (17.83%)	No (82.17%)	Yes (35.46%)	No (64.54%)
Radio								
Almost Everyday	25.5	26.9	26.0	25.5	24.5	27.4	26.0	24.5
Few days a week	11.4	5.9	11.9	11.4	11.3	12.6	11.4	11.3
Never	63.2	67.2	62.1	63.2	64.2	60.1	62.6	64.2
p-value	<.001		.166		.133		.137	
TV								
Almost Everyday	47.6	43.9	49.9	47.6	47.4	55.1	51.1	47.4
Few days a week	7.7	7.4	7.5	7.7	7.5	7.3	8.5	7.5
Never	44.7	48.7	42.6	44.7	45.1	37.5	40.4	45.1
p-value	<.001		.004		.047		.003	
Number of ANC visits								
< 3	46.2	96.7	39.8	46.2	46.8	49.0	29.3	46.8
3/3+	53.8	3.4	60.2	53.8	53.2	51.0	70.7	53.2
p-value	<.001		<.001		<.001		<.001	

Akan ethnic group (32.7%), women from households with the middle wealth quintile (24.1%), and 45.7% of them had delivered at least once. Also, majority of participants who received three doses of IPTp-SP did not use newspaper, radio and TV respectively (75, 62.6 and 40.4%) as well as those who made at least three ANC visits (70.7%).

Table 2 shows the results of multivariable regression model. The findings of this study showed that women's age, ethnicity and number of ANC visits were significantly associated with taking adequate doses of IPTp-SP drugs. Whereas, women's educational level and number of ANC visits were statistically associated with increased odds of taking IPTp-SP drugs. Women of age group 25–29 years had higher odds (OR = 2.028, 95%CI = 1.120–3.669) of taking the adequate doses of IPTp-SP drugs compared to those aged 15–19 years. When stratified by areas, this positive association was observed only for urban women aged 25–29 years (OR = 3.943, 95%CI = 1.431–10.86) compared to those aged 15–19 years. Having primary and secondary/high educational level increased the odds of taking IPTp-SP drugs (OR = 2.504, 95%CI = 1.020–6.146) and (3.298,95%CI = 1.343–8.097) respectively, compared to those with no formal education. Stratified by areas, the significant association between education and IPTp-SP drugs was true for urban women only who had secondary/high educational level (OR = 3.212,95%CI = 1.002–10.29) compared to those with no formal education. Similarly, we found a strong association between ANC visits and IPTp-SP drugs (OR = 1.656, 95%CI = 1.194–2.299). Upon stratification by areas, the odds of taking IPTp-SP drugs were significantly higher among women who attended at least 4

ANC visits in both urban (OR = 2.126, 95%CI = 1.214–3.724) and rural areas (OR = 1.597, 95%CI = 1.037–2.459) compared to those who attended less than 4 ANC visits. Our results also indicated that IPTp-SP doses was associated with 4 ANC visits (OR = 3.291, 95%CI = 2.157–5.020) compared to counterparts who attended less than 4 ANC visits. Also, the probability of taking adequate doses of IPTp-SP was higher among women with at least 4 ANC visits in both urban (OR = 2.777, 95%CI = 1.286–5.999) and rural areas (OR = 4.087, 95%CI = 2.350–7.107) compared to those who had less than 4 ANC visits. However, the odds of taking the adequate doses of IPTp-SP drugs were lower among women who were from Mandé Du Nord ethnic group (OR = 0.378, 95%CI = 0.145–0.983) compared to those from another ethnicity.

Table 3 shows the correlates of using TT immunization among pregnant women in Ivory Coast. After adjusting for possible confounding by each of the covariates in the multivariate logistic regression, pregnant women's age, parity and number of ANC visits were associated with TT immunization. Only ANC visits was significantly associated with a higher odd of receiving the adequate doses of TT immunization.

Accordingly, the probability of using TT immunization was significantly higher among women aged 35–39 years (OR = 7.842, 95%CI = 1.088–56.50) compared to those 15–19 years old. This result is true for rural women only. Having higher parity (> 4) was significantly associated with lower odds of receiving TT immunization for rural participants only (OR = 0.218, 95%CI = 0.055–0.858) compared to those who had delivered at least once. The model also reveals that women who had attended 4

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Table 2 Correlates of using IPTp-SP drugs among pregnant women in Ivory Coast

	Antimalarial drug			Adequate dose of antimalarial drug		
	Total	Urban (*n* = 3845)	Rural (*n* = 5738)	Total	Urban (*n* = 3845)	Rural (*n* = 5738)
Age groups (15–19)						
20–24	0.779	0.580	0.954	1.665	1.803	1.662
	[0.482,1.258]	[0.256,1.313]	[0.511,1.783]	[0.939,2.955]	[0.637,5.107]	[0.781,3.539]
25–29	1.410	1.327	1.476	2.028[*]	3.943[**]	1.479
	[0.832,2.388]	[0.575,3.061]	[0.715,3.049]	[1.120,3.669]	[1.431,10.86]	[0.653,3.347]
30–34	1.166	1.060	1.135	1.945	2.860	1.975
	[0.642,2.118]	[0.429,2.616]	[0.475,2.714]	[0.977,3.872]	[0.965,8.480]	[0.701,5.567]
35–39	1.821	2.215	1.576	2.197	2.130	2.335
	[0.841,3.941]	[0.690,7.109]	[0.500,4.969]	[0.935,5.162]	[0.577,7.863]	[0.622,8.763]
40–49	1.200	3.624	0.651	1.750	1.807	2.179
	[0.408,3.523]	[0.513,25.59]	[0.156,2.708]	[0.535,5.719]	[0.276,11.84]	[0.383,12.39]
Residency (Urban)						
Rural	1.010	NA	NA	1.314	NA	NA
	[0.654,1.559]			[0.815,2.118]		
Education (None)						
Primary	2.504[*]	2.883	2.810	1.276	2.446	0.790
	[1.020,6.146]	[0.872,9.532]	[0.596,13.24]	[0.345,4.710]	[0.380,15.74]	[0.0950,6.574]
Secondary/higher	3.298[**]	3.212[*]	4.309	1.667	1.928	1.565
	[1.343,8.097]	[1.002,10.29]	[0.889,20.88]	[0.452,6.153]	[0.306,12.15]	[0.184,13.32]
Ethnicity (Other)						
Akan	1.051	0.875	1.214	0.784	0.500	0.909
	[0.671,1.645]	[0.441,1.735]	[0.630,2.341]	[0.464,1.325]	[0.220,1.137]	[0.406,2.031]
Mandé Du Nord	0.927	0.543	2.762	0.702	0.378[*]	0.754
	[0.519,1.656]	[0.250,1.178]	[0.876,8.711]	[0.349,1.411]	[0.145,0.983]	[0.178,3.187]
Gur	0.797	0.653	1.111	0.542	0.392	0.364
	[0.442,1.438]	[0.277,1.537]	[0.450,2.741]	[0.272,1.080]	[0.148,1.038]	[0.111,1.201]
Non-Ivorian	0.829	0.811	0.839	0.554	0.405	0.489
	[0.496,1.385]	[0.367,1.795]	[0.406,1.732]	[0.293,1.044]	[0.153,1.071]	[0.181,1.322]
Wealth (Poorest)						
Poorer	0.770	1.169	0.685	1.149	1.114	0.960
	[0.456,1.300]	[0.657,2.521]	[0.393,1.196]	[0.614,2.153]	[0.551,2.121]	[0.485,1.902]
Middle	0.884	0.690	0.794	1.336	0.337	1.239
	[0.499,1.567]	[0.143,3.326]	[0.414,1.523]	[0.690,2.587]	[0.0725,1.567]	[0.563,2.727]
Higher	0.663	0.406	0.659	1.264	0.460	1.084
	[0.340,1.293]	[0.0853,1.933]	[0.286,1.514]	[0.579,2.760]	[0.0985,2.148]	[0.397,2.955]
Highest	0.689	0.399	1.229	0.962	0.458	0.522
	[0.331,1.434]	[0.0799,1.990]	[0.383,3.942]	[0.414,2.238]	[0.0950,2.206]	[0.135,2.022]
Newspaper (Never)						
Few days a week	1.047	1.632	0.512	1.025	1.024	1.002
	[0.601,1.825]	[0.806,3.304]	[0.182,1.441]	[0.542,1.938]	[0.455,2.308]	[0.310,3.242]
Almost everyday	1.211	1.467	0.848	1.575	1.380	1.901
	[0.746,1.965]	[0.788,2.731]	[0.348,2.067]	[0.907,2.734]	[0.663,2.873]	[0.723,4.999]

Table 2 Correlates of using IPTp-SP drugs among pregnant women in Ivory Coast *(Continued)*

	Antimalarial drug			Adequate dose of antimalarial drug		
	Total	Urban (*n* = 3845)	Rural (*n* = 5738)	Total	Urban (*n* = 3845)	Rural (*n* = 5738)
Radio (Never)						
Few days a week	1.129	1.046	1.207	1.263	0.676	2.129
	[0.733,1.738]	[0.549,1.993]	[0.648,2.247]	[0.764,2.086]	[0.320,1.429]	[0.973,4.661]
Almost everyday	1.188	0.850	1.460	1.104	0.917	1.436
	[0.846,1.668]	[0.508,1.422]	[0.901,2.363]	[0.747,1.633]	[0.506,1.660]	[0.791,2.608]
TV (Never)						
Few days a week	0.813	1.616	0.736	1.084	0.371	1.292
	[0.455,1.455]	[0.451,5.788]	[0.364,1.490]	[0.552,2.127]	[0.0682,2.014]	[0.540,3.092]
Almost everyday	0.658	0.982	0.592	1.102	1.820	1.078
	[0.423,1.026]	[0.377,2.558]	[0.346,1.013]	[0.662,1.835]	[0.624,5.308]	[0.560,2.074]
Parity (1/2)						
3/4	0.954	0.931	0.994	0.819	1.226	0.628
	[0.637,1.427]	[0.511,1.697]	[0.550,1.797]	[0.518,1.295]	[0.616,2.441]	[0.315,1.255]
> 4	0.795	0.489	1.069	0.921	1.177	0.676
	[0.432,1.462]	[0.173,1.376]	[0.457,2.500]	[0.458,1.851]	[0.360,3.846]	[0.257,1.780]
ANC (< 4)						
4	1.656**	2.126**	1.597*	3.291***	2.777**	4.087***
	[1.194,2.299]	[1.214,3.724]	[1.037,2.459]	[2.157,5.020]	[1.286,5.999]	[2.350,7.107]

Exponentiated coefficients; 95% confidence intervals in brackets
* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001

ANC visits markedly increased the odds of receiving TT immunization (OR = 2.347, 95%CI = 1.384–3.981) compared to those who had attended less. This association was also true for rural women only (OR = 2.397, 95%CI = 1.172–4.901). The odds of receiving the adequate doses of TT immunization were higher among women who had attended 4 ANC visits (OR = 1.968, 95%CI = 1.398–2.771) compared to those with less ANC attendance. This observation is similar for women in rural areas (OR = 2.387, 95%CI = 1.529–3.726), but different for women in urban areas.

Discussion

Despite numerous government interventions, tetanus and malaria related morbidity and mortalities remain a significant public health challenge across Africa. In the last few years, public health programs have been trying to promote preventive techniques such as the use of tetanus toxoid and IPTp-SP, however, challenges remain in increasing the prevalence of these highly cost-effective strategies.

In Ivory Coast, the current policies for malaria and TT immunization are those recommended by WHO for the prevention of malaria and tetanus during pregnancy using intermittent preventive treatment with sulfadoxine pyrimethamine and TT vaccination respectively. These policies are excellent with a high potential of reducing

the burden of these diseases in this country. However, implementation of these policies is limited, and women's uptake of the vaccines sometimes hindered by partners objecting to it [37, 38].

In this study, we found the proportion of women who took IPTp-SP drugs (17.83%) and in adequate doses (35.46%) was much lower than that of those who received TT immunization and in adequate doses among pregnant Ivory Coast women. This observation is dissimilar to the previous studies that found higher rates of taking IPTp-SP drugs [18, 39, 40]. This disparity could be influenced by distance of health facilities from the women's homes, low education of the women, household income level of the women and lack of information about the effectiveness of taking IPTp-SP drugs.

Using regression analysis model, we found that women's age was an important indicator of the taking of both IPTp-SP drugs and TT immunization. For instance, women aged 25–29 years had higher odds of receiving adequate doses of IPTp-SP drugs compared to those aged 15–19 years. This finding is in line with previous cross-sectional studies conducted in Malawi and Tanzania [32, 41]. Similarly, the odds of TT immunization usage were significantly higher among women aged 35–39 years compared to those aged 15–19 years. However, the association was significant for only rural women. This finding is consistent with the study by Dubale and colleagues, that

Table 3 Correlates of using tetanus toxoid among pregnant women in Ivory Coast

	Tetanus toxoid			Adequate dose of tetanus toxoid		
	Total	Urban (*n* = 3845)	Rural (*n* = 5738)	Total	Urban (*n* = 3845)	Rural (*n* = 5738)
Age groups (15–19)						
20–24	1.168	1.320	1.353	1.147	1.509	1.126
	[0.494,2.759]	[0.183,9.516]	[0.492,3.722]	[0.692,1.903]	[0.661,3.447]	[0.576,2.201]
25–29	1.249	0.463	3.061	0.831	1.526	0.579
	[0.497,3.143]	[0.0821,2.609]	[0.825,11.36]	[0.489,1.411]	[0.665,3.500]	[0.278,1.205]
30–34	0.867	0.337	2.574	0.654	0.952	0.568
	[0.311,2.417]	[0.0535,2.120]	[0.545,12.16]	[0.355,1.208]	[0.390,2.325]	[0.229,1.407]
35–39	1.386	0.449	7.842[*]	0.621	1.077	0.435
	[0.393,4.887]	[0.0556,3.629]	[1.088,56.50]	[0.289,1.335]	[0.343,3.382]	[0.141,1.341]
40–49	0.858	07942	1.002	0.450	0.316	0.499
	[0.184,3.991]	[0.490,2.012]	[0.144,6.969]	[0.156,1.301]	[0.0583,1.715]	[0.112,2.223]
Residency (Urban)						
Rural	0.803	NA	NA	0.676	NA	NA
	[0.388,1.662]			[0.433,1.055]		
Education (None)						
Primary	0.913	1.117	1.653	1.042	1.065	0.830
	[0.189,4.410]	[0.101,12.31]	[0.145,18.85]	[0.389,2.790]	[0.276,4.117]	[0.164,4.195]
Secondary/higher	1.259	1.476	2.951	1.013	0.800	0.958
	[0.257,6.164]	[0.139,15.69]	[0.239,36.51]	[0.379,2.710]	[0.215,2.973]	[0.185,4.951]
Ethnicity (Other)						
Akan	0.841	0.553	1.720	1.050	1.076	1.108
	[0.367,1.929]	[0.126,2.432]	[0.560,5.284]	[0.667,1.651]	[0.533,2.171]	[0.584,2.104]
Mandé Du Nord	0.465	0.414	0.325	1.412	1.551	1.876
	[0.169,1.278]	[0.0863,1.984]	[0.0610,1.732]	[0.775,2.574]	[0.701,3.432]	[0.636,5.529]
Gur	0.883	0.415	5.587	0.589	0.583	0.457
	[0.310,2.517]	[0.0821,2.103]	[0.914,34.15]	[0.325,1.068]	[0.245,1.390]	[0.181,1.151]
Non-Ivorian	0.663	1.442	0.476	0.902	0.993	0.831
	[0.258,1.701]	[0.201,10.33]	[0.147,1.542]	[0.533,1.528]	[0.443,2.225]	[0.396,1.746]
Wealth (Poorest)						
Poorer	1.294	1.219	1.252	0.899	0.813	0.914
	[0.566,2.958]	[0.663,2.381]	[0.513,3.058]	[0.524,1.543]	[0.589,2.610]	[0.516,1.617]
Middle	1.550	2.934	1.453	1.237	2.283	1.285
	[0.614,3.915]	[0.167,51.57]	[0.471,4.483]	[0.696,2.199]	[0.498,10.47]	[0.664,2.488]
Higher	0.824	2.485	0.539	1.190	2.214	1.073
	[0.289,2.348]	[0.144,42.82]	[0.140,2.068]	[0.603,2.349]	[0.485,10.11]	[0.464,2.481]
Highest	1.148	4.839	0.353	0.774	1.427	0.859
	[0.336,3.919]	[0.249,94.02]	[0.0512,2.438]	[0.370,1.620]	[0.302,6.738]	[0.282,2.618]
Newspaper (Never)						
Few days a week	1.516	2.328	0.853	1.096	1.050	0.976
	[0.618,3.719]	[0.703,7.709]	[0.161,4.526]	[0.628,1.912]	[0.523,2.107]	[0.350,2.726]
Almost everyday	1.794	2.315	0.938	1.284	1.431	0.837
	[0.829,3.884]	[0.793,6.759]	[0.233,3.767]	[0.789,2.090]	[0.759,2.698]	[0.351,1.997]

Table 3 Correlates of using tetanus toxoid among pregnant women in Ivory Coast (Continued)

	Tetanus toxoid			Adequate dose of tetanus toxoid		
	Total	Urban ($n = 3845$)	Rural ($n = 5738$)	Total	Urban ($n = 3845$)	Rural ($n = 5738$)
Radio (Never)						
Few days a week	0.846	1.488	0.512	1.270	1.886	0.885
	[0.409,1.750]	[0.421,5.268]	[0.188,1.391]	[0.807,1.999]	[0.944,3.769]	[0.463,1.693]
Almost everyday	0.896	0.735	1.068	1.014	1.082	1.025
	[0.499,1.608]	[0.291,1.856]	[0.455,2.506]	[0.719,1.430]	[0.648,1.808]	[0.629,1.670]
Radio (Never)						
Few days a week	0.723	0.992	0.328	0.854	0.659	1.088
	[0.298,1.756]	[0.0807,12.20]	[0.107,1.003]	[0.473,1.543]	[0.199,2.185]	[0.522,2.267]
Almost everyday	0.951	0.513	0.463	1.266	1.183	1.420
	[0.448,2.018]	[0.489,1.417]	[0.177,1.216]	[0.808,1.982]	[0.458,3.056]	[0.829,2.432]
Parity (1/2)						
3/4	0.615	0.445	1.050	1.341	1.435	1.301
	[0.308,1.227]	[0.166,1.197]	[0.362,3.044]	[0.888,2.025]	[0.774,2.663]	[0.715,2.369]
> 4	0.449	0.694	0.218[*]	1.400	1.886	1.243
	[0.175,1.149]	[0.134,3.597]	[0.0552,0.858]	[0.756,2.594]	[0.647,5.497]	[0.536,2.880]
ANC (< 4)						
4	2.347[**]	2.493	2.397[*]	1.968[***]	1.531	2.387[***]
	[1.384,3.981]	[0.982,6.331]	[1.172,4.901]	[1.398,2.771]	[0.835,2.807]	[1.529,3.726]

Exponentiated coefficients; 95% confidence intervals in brackets
[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

involved women in Ethiopia also showing an association between higher age and utilization of TT immunization [42]. There is a possibility that women in higher age groups have been exposed to multiple pregnancies and also had opportunity to attend more ANC visits where information about TT immunization was given compared to their younger counterparts.

We also found that participants who attended at least four ANC visits had higher odds of taking IPTp-SP drugs and TT immunization compared to those who attended less. Having at least four ANC visits was significantly associated with higher odds of receiving adequate doses of IPTp-SP drugs and TT immunization compared to those who attended less than four ANC visits. The probability of taking IPTp-SP drugs was significantly higher among pregnant women who had at least four ANC visits during the last pregnancy compared to their counterparts. This finding with regard to healthcare service is similar to studies conducted in Ghana [43, 44], Malawi [32, 45], Mali [46], Cameroon [47], and Tanzania [48, 49]. Concerning adequate doses of TT immunization, our findings also revealed that women who attended at least four ANC visits were more likely to have been immunized with protective doses of TT compared to those who made fewer visits. Other studies also verified this association [33, 50, 51]. This is perhaps because women who attend more ANC visits

are more likely to be informed about the importance of IPTp-SP drugs and would therefore receive it than those who attended less.

There was a significant association between utilization of TT immunization and participant's parity. Our study revealed that women with higher parity had lower odds of TT immunization usage compared to those of lower parity (1–2). This was supported by findings from previous studies that have found higher parity (> 4 pregnancies) to be a significant predictor of TT immunization [52, 53]. The possible reason may be due to women's previous experience with delivery and the side effects of TT immunization. It's also possible that women with higher parity are less likely to have better education and employment. This hypothesis is supported by the present findings as well. For instance, women with primary and secondary/higher educational level had higher odds of taking IPTp-SP drugs compared to those with no education. This result is consistent with previous studies done in Malawi, Uganda and Ghana in which high maternal education was significantly associated with high uptake of IPTp-SP drugs [18, 54–57]. This is likely because education can empower women to take better and more effective decisions regarding their health issues, which can contribute to adequate utilization of healthcare services like IPTp-SP drugs including ANC attendance. Women of Mendé ethnicity

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had lower odds of receiving adequate doses of IPTp-SP drugs compared to those from other ethnicities. There was no evidence in Africa, but ethnic differences were found in US [58–61]. Possible explanation could be to the lack of confidence in vaccination among ethnic groups [62, 63].

Strengths and limitations
The current study was not without limitations. Firstly, the study was based on secondary data from a cross sectional survey. Hence, it cannot be used to infer causality but only to show association between variables [64, 65]. Secondly, the data was collected three years ago, and although the disparity in taking IPTp-SP drugs and TT immunization still exists, the underlying causes may have changed. As strengths, the sample size was large, and the findings can be generalized for women aged 15–49 years. The cross-sectional nature of the data prevented from making any causal assumptions. The prevalence of IPT-SP and TT use was self-reported and therefore remains subject to reporting bias. We were also unable to assess during which trimester the tetanus toxoid and IPTp-SP were administered. Future studies should be conducted aiming at establishing the link of causality between ANC attendance and TT vaccination/IPTp-SP coverage.

Conclusion
In general, our results indicate that uptake of these vaccines is low with adequate IPTp-SP dose uptake much lower than adequate TT dose uptake. Age, education level, parity, ethnicity and number of ANC visits were found to be significantly associated with taking IPTp-SP drugs and TT immunization and their adequate doses respectively. Vaccination promotion efforts need to be intensified to protect pregnant women and could reduce adverse health outcomes among the newborn in Ivory Coast.

Abbreviations
ANC: Antenatal care; CI: Confidence interval; IPTp-SP: Intermittent preventive treatment of malaria during pregnancy with sulfadoxine-pyrimethamine; MICS: Multiple Indicator Cluster Survey; OR: Odds ratio; TT: Tetanus toxoid; WHO: World Health Organization

Availability of data and materials
Data for this study are available in the public domain of the UNICEF website: https://mics-surveys-prod.s3.amazonaws.com/MICS5/West%20and%2 0Central%20Africa/Côte%20d%27Ivoire/2016/Final/Cote%20d%27Ivoire%202 016%20MICS_French.pdf

Ethics approval and consent to participate
The surveys were approved by the Ethics Committee of the Global MICS, USA and the National Research Ethics Committee of Ivory Coast. The study was based on the analysis of anonymized secondary datasets available in the public domain of the Multiple Indicator Cluster Survey (MICS). Before each interview is conducted, an informed consent statement is read to the respondent, who may accept or decline to participate. Most importantly, the informed consent statement emphasizes that participation is voluntary; that the respondent may refuse to answer any question or terminate participation at any time; and that the respondent's identity and information will be kept strictly confidential.

Consent for publication
Not applicable.

Competing interests
Sanni Yaya and Ghose Bishwajit are Editorial Board Members of this journal.

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