

Adherence to intermittent preventive treatment for malaria in pregnancy in urban Kano, northern Nigeria

Zubairu Iliyasu¹, Auwalu Umar Gajida¹, Hadiza S. Galadanci²,
Isa Sadeeq Abubakar¹, Abdullahi Suleiman Baba¹, Abubakar M. Jibo¹,
Muktar H. Aliyu³

¹Department of Community Medicine, ²Department of Obstetrics & Gynaecology, Aminu Kano Teaching Hospital & Bayero University, Kano, Nigeria, ³Vanderbilt Institute for Global Health, Nashville, TN, USA

Malaria in pregnancy is associated with substantial risk of maternal and fetal morbidity and mortality. The uptake of preventive antimalarials is low in malaria endemic countries, including Nigeria. Using a cross-sectional study design, we assessed factors associated with uptake and adherence to intermittent preventive treatment for malaria in pregnancy (IPTp) among antenatal attendees in primary health centers in Kano, northern Nigeria ($n=239$). A total of 137 respondents (57.3%) reported receiving preventive antimalarials, but only 88 respondents (36.8%) [95% confidence interval (CI): 30.7–43.3%] reported ingesting pills in the clinic under supervision. Factors associated with adherence to IPTp after adjustment for potential confounding included: advanced maternal age [adjusted odds ratio (AOR) (95%CI)=2.1 (1.3–6.37)], higher educational attainment [AOR (95%CI)=3.2 (1.32–6.72)], higher parity [AOR (95%CI)=1.6 (1.07–3.94)], lower gestational age at booking [AOR (95% CI)=1.72 (1.24–3.91)], and use of insecticide-treated nets [AOR (95%CI)=2.03 (1.13–3.26)]. There is a need for strengthening health systems and addressing cultural factors that impede efforts at expanding coverage of malaria prevention strategies in Nigeria.

Keywords: Malaria, Intermittent preventive therapy, Nigeria, Pregnancy

Introduction

According to the World Malaria Report 2011, there were an estimated 216 million episodes of malaria in 2010 which resulted in 655 000 deaths across the globe. Of these deaths, 91% occurred in Africa.¹ About 30 million women in malarious areas of sub-Saharan Africa get pregnant each year.² These women are particularly vulnerable to malaria because pregnancy reduces women's relative immunity to malaria, thus making them more susceptible to infection. Malaria during pregnancy poses substantial risk to both mother and baby. Malaria increases the risk of spontaneous abortion, stillbirth, premature delivery, and low birth weight, in addition to several adverse maternal effects, such as anemia, postpartum hemorrhage, and pre-eclampsia.^{3–8}

Estimates of malarial parasitemia in pregnancy in Nigeria range from 31% in Abuja, 39.2% in Kano, to 60% in Lagos^{9–11} Nigeria adopted the three-pronged approach of the Roll Back Malaria program in

2005.¹² This approach includes intermittent preventive treatment during pregnancy (IPTp), insecticide-treated nets (ITNs), and case management of clinical malaria. IPTp involves the provision of at least two preventive treatment doses of an effective antimalarial drug [preferably sulfadoxine–pyrimethamine (SP)] in the second and third trimesters, under the supervision of a trained health care provider.^{13,14} IPTp has been shown to be safe, inexpensive, effective, and acceptable to pregnant women.^{14–16}

A recent national survey reported that only 36% of pregnant women received two doses of IPTp in 2010, considerably less than the 80% target set by the Roll back Malaria program.¹⁷ This figure is consistent with at least two reports from southwest and southeast Nigeria.^{18,19} However, northern Nigeria has unique cultural characteristics which could affect the uptake of IPTp. For instance, the practice of seclusion of women (*Purdah*) restricts the utilization of clinic-based maternal health services, especially for delivery. To our knowledge, there are no studies on adherence to IPTp from the northern part of Nigeria. We have previously documented malarial parasitemia

Correspondence to: MH Aliyu, Vanderbilt Institute for Global Health, 2525 West End Avenue, Suite 750, Nashville, TN 37203, USA. Email: muktar.aliyu@vanderbilt.edu

rate of 39.2% among antenatal clients in that part of the country.¹¹ Therefore, this study sets out to assess the correlates of IPTp use, in addition to knowledge and attitudes to IPTp among women attending urban primary health care centers in Kano, the commercial nerve centre of northern Nigeria. The findings from this study will yield valuable information that can be used to guide planning of interventions for improving the adoption of IPTp in urban Nigeria.

Methods

Study area

The study was conducted in Kano Municipal local government area (LGA), one of the 44 LGAs of Kano State, Nigeria (estimated population: 365 525).²⁰ Most of the women are fulltime homemakers, of Hausa–Fulani ethnicity. Malaria is endemic in this LGA with perennial transmission. The LGA is urban and is divided into 10 wards. There are 12 primary health care centers (PHCs) and four general hospitals. The PHCs are staffed by community health officers, community health extension workers, and a few nurses/midwives. Antenatal care services are conducted on Tuesdays and Thursdays in the PHCs. Other activities at PHCs include distribution of free ITNs supplied by the Federal Ministry of Health. Five frequency modulation (FM) radio stations (Freedom Radio, Rahama Radio, Cool FM, Radio Kano 2 FM, and Wazobia radio) serve residents of urban Kano and neighboring states. In addition, women in the study area are ardent listeners of foreign radio stations like the Hausa language service of the BBC, VOA, and Radio Deutsche Welle Hausa Service. These stations air health programs including those targeted at preventing malaria during pregnancy. Local, national, and global satellite television stations occasionally broadcast health programs that are viewed in the study area. Mobile telephone services are nearly universal, but access to internet services is very limited.

Study population

The study population comprised all consenting pregnant women attending antenatal care at all the primary health centers rendering antenatal services in Kano Municipal LGA between June 2011 and July 2011.

Study design and sampling

A cross-sectional descriptive design was used. We applied Fisher formula²¹ to compute the required sample size for the survey, using estimates of reported IPTp use among pregnant women in a previous study.²² In order to detect IPTp use with an error rate of 5% and 95% confidence interval (CI), the minimum sample size was inflated by 10% and rounded up to 250 to account for non-response. Respondents were selected using probability proportionate to size (of average annual attendance) from three randomly

selected antenatal clinics from the six PHCs rendering antenatal services. In each sampled PHC, systematic sampling technique was used to recruit respondents. Using the estimate of the average clinic attendance, a sampling interval was determined for each PHC and applied accordingly, with balloting employed to determine the first enrollee.

Data collection methods

Information was collected using an interviewer-administered questionnaire adapted from a previous study.¹⁸ The questionnaire was structured with a combination of close and open-ended questions. Questions eliciting attitude and perceptions were on a five-point Likert scale or open ended. The questionnaire comprised questions on socio-demographic characteristics, obstetric history, and knowledge of malaria and IPTp, including attitudes to IPTp and antenatal clinic attendance. In the participating clinics, gestational age was routinely estimated by the last menstrual period and symphysis-fundal height measurement. Ultrasound scan was utilized for dating in cases of unsure date, first trimester cases, or when there was discrepancy between last menstrual period and symphysis-fundal height. Information on perception of attitude and activities of antenatal clinic staff toward IPTp was also assessed. The questionnaire was translated into Hausa language and administered by four trained female research assistants. Ethical approval for this study was obtained from the Aminu Kano Teaching Hospital Institutional Review Board.

Data analysis

Data entry and analysis were performed using Statistical Package for Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL, USA). Data were summarized using frequency tables, graphs, means, and standard deviations (SDs). Correct responses to knowledge questions were awarded one mark and wrong responses scored zero. The total scores were converted to percentages and graded as poor (0–39%), fair (40–69%), and good (70–100%). A woman was considered adherent if she swallowed the prescribed dose under the supervision of health workers at the clinic. To identify factors associated with adherence, bivariate analysis was employed using Chi-squared test or Chi-squared test for trend, as appropriate. Adjustment for confounding among factors was effected using logistic regression analysis. The crude odds ratio (OR) provides a measure of the strength of relationship between adherence to IPT (dependent variable) and each independent variable at the bivariate level. Adjusted odds ratios (AORs) were obtained by including variables found to be significantly associated with adherence at bivariate level *en bloc* in a logistic regression model. This was to determine the independent effects of various levels

of these independent variables while controlling for the effect of the others. The corresponding 95% confidence intervals were also reported. All tests of significance were considered significant if $P < 0.05$.

Results

Socio-demographic characteristics

Of a total of 250 pregnant women approached to participate in the study, 239 agreed, giving a response rate of 95.6%. The mean (SD) age of respondents was 26.3 ± 6.8 years and majority were in the third decade of life (Table 1). Most respondents 228 (95.4%) were Hausa–Fulani Muslims. Fifty respondents (21%) had at least secondary education; the majority either had primary education (23.4%) or Qur'anic education (55.6%) with no formal schooling. Most of the respondents (97.5%) were married. Nearly all respondents (94.5%, $n=226$) were fulltime homemakers. A few others were seamstresses (2.5%), teachers (1.7%), or health workers (1.3%). One hundred and five respondents (43.9%) walked to the clinic, spending a median of 10 minutes. The rest either used private transport in form of motorcycle, family car, or public transport.

Obstetric history and gestational age at booking

Twenty-seven (11.3%) of the respondents were primigravida, 117 (49.0%) had two to four total pregnancies, while the rest 95 (39.7%) had five or more pregnancies. In the index pregnancy, only 7 (2.9%) of the women booked in the first trimester (≤ 12 weeks), 151 (63.2%) registered in the second trimester (13–24 weeks), and 81 (33.9%) booked in the third trimester (25–40 weeks), respectively.

Attitude of pregnant women to taking drugs during pregnancy

Out of the 239 respondents, 106 (44.4%) stated that they were concerned about taking drugs during pregnancy except if it becomes necessary due to illness. They also reported that they needed the consent of their husbands before taking any such drugs that were not bought by their spouses. One hundred and ninety-eight women (82.8%) perceived their husbands' as supportive towards use of drugs for malaria prevention in pregnancy. Before the insistence of the health workers that they should swallow the drugs in the clinic, they said some of the drugs that were given to them or prescribed during antenatal visits were not actually bought or even if they were bought they would swallow a few especially if it was for prevention and not treatment. Another concern is lack of enough cups and drinking water in the clinic. They suggested that they be allowed to use sachet water which could be taken without use of cups and that this will reduce contact with an unknown person's saliva.

Knowledge of malaria and IPTp

Majority 216 (90.4%) of the respondents said that they have heard about IPTp. The sources of information on IPTp include electronic media 193 (89.4%) and health workers during antenatal clinic 16 (7.4%). All respondents knew the local Hausa name for malaria and they all knew that it was transmitted by mosquito bite. On whether there are different types of mosquitoes, only a few of the women ($n=9$) who happened to be teachers or health workers knew that there are different types of mosquitoes transmitting different diseases. The majority thought that all mosquitoes transmit malaria. Using a combination of respondents' knowledge of malaria and IPTp, 75 (31.2%), 137 (57.6%), and 27 (11.2%) of the respondents had good, fair, and poor knowledge of IPTp, respectively.

IPT and ITN use in the index pregnancy

One hundred and thirty-seven (57.3%) reported that they have received the expected number of tablets from health workers during antenatal visits, but only

Table 1 Socio-demographic and obstetric characteristics of antenatal attendees in primary health centers in Kano, Nigeria

Characteristics	Frequency
	No. (%)
Age (years)	
<20	24 (10.0)
20–29	42 (17.6)
30–39	120 (50.2)
≥ 40	53 (22.2)
Total	239 (100.0)
Educational level	
Non-formal	133 (55.6)
Primary	56 (23.4)
Secondary	42 (17.6)
Post-secondary	8 (3.4)
Total	239 (100.0)
Marital status	
Married	233 (97.5)
Divorced/widowed	6 (2.5)
Total	239 (100.0)
Ethnicity	
Hausa	177 (74.1)
Fulani	51 (21.3)
Others	11 (4.6)
Total	239 (100.0)
Religion	
Islam	229 (95.8)
Christianity	10 (4.2)
Total	239 (100.0)
No. of pregnancies	
1	27 (11.3)
2–4	117 (49.0)
≥ 5	95 (39.7)
Total	239 (100.0)
Gestational age at booking	
≤ 12 weeks	7 (2.9)
13–24 weeks	151 (63.2)
25–40 weeks	81 (33.9)
Total	239 (100.0)
Use of ITN	
Yes	92 (38.5)
No	147 (61.5)

Note: ITN, insecticide-treated net.

88 (36.8%) of the 239 respondents reported to have swallowed the expected number of doses appropriate for their current gestational age in the clinic under the supervision of health care workers. The remaining 49 women who received but did not take the drugs under supervision did so for various reasons: 23 (46.9%) of them did not want to share cups in the clinic, 11 (22.4%) claimed that they did not have money to buy sachet water to swallow the drugs while the rest 15 (30.6%) wanted to get permission from their husbands before taking the drugs. Almost a quarter 21 (23.8%) of those who had used IPTp during the index pregnancy expressed concern about possible adverse effect of SP on their pregnancies. Ninety-two (38.5%) of the 239 pregnant women used ITN during the current pregnancy.

Factors associated with adherence to IPTp

There was an inverse relationship between the level of adherence to IPTp and gestational age at booking ($P < 0.01$) (Table 2). In contrast, adherence to IPTp significantly increased with the number of pregnancies ($P < 0.05$). Also, a higher proportion of women who had at least secondary education were adherent, compared to their less well-educated counterparts ($P < 0.01$). Furthermore, a higher proportion of women who used ITN were adherent compared to non-users ($P < 0.01$). In contrast, out of the 212 women who had fair or good knowledge of IPTp, 79 (37.3%) were adherent compared to 9 (33.3%) of

those who had poor knowledge. Similarly, out of the 198 women whose husbands were perceived to have positive attitude towards use of drugs for malaria prevention in pregnancy, 74 (37.4%) were adherent compared to 14 (34.1%) of those whose husbands had negative attitude. Of the 105 women who walked to the clinics, 37 (35.2%) were adherent to IPTp compared to 51 (38.1%) of those who were conveyed in private or commercial vehicles. These differences were not significant ($P > 0.05$). Following multivariate logistic regression analysis including variables that were significantly associated with adherence to IPTp at bivariate level (Table 2), advancing maternal age [AOR (95%CI)]=2.1 (1.3–6.37), higher educational attainment [AOR (95%CI)]=3.2 (1.32–6.72), higher parity [AOR (95%CI)]=1.6 (1.07–3.94), lower gestational age at booking [AOR (95%CI)]=1.72 (1.24–3.91), and ITN use [AOR (95%CI)]=2.03 (1.13–3.26) remained significantly associated with IPTp adherence. Specifically, older, more experienced women were twice as likely to adhere to IPTp compared to inexperienced teenage mothers. Similarly, women that attained at least secondary education were more than three times likely to adhere to IPTp compared to those with non-formal education. Women who had two to four pregnancies had an increased likelihood of adhering to IPTp compared to primigravida. Similarly, grandmultiparous women (≥ 5 pregnancies) were more likely to adhere to IPTp. Also,

Table 2 Factors associated with IPTp adherence among antenatal attendees in primary health centers in Kano, Nigeria

Factors	Frequency		Crude OR‡ (95%CI)	P value	Adjusted OR§ (95%CI)	P value
	No.	(%)				
Age group (years)	Adherent					
<20*	2	(8.3)	1.0			
20–29	14	(33.3)	5.5 (1.01–9.3)	0.024	1.7 (0.47–5.31)	0.12
30–39	54	(45.0)	9.0 (1.91–11.2)	0.0008	2.1 (1.3–6.37)	0.03
≥40	18	(34.0)	5.7 (1.29–10.99)	0.018	1.5 (1.27–4.53)	0.02
Test for effect†						0.0023
Educational level	Non-formal*		1.0			
Primary	15	(26.8)	1.09 (0.51–2.34)	0.80	0.79 (0.82–1.92)	0.36
Secondary/tertiary	35	(70.0)	5.83 (2.71–12.7)	<0.001	3.2 (1.32–6.72)	0.01
Test for effect†						0.0031
No. of pregnancies	1*		1.0			
2–4	4	(14.8)	3.73 (1.12–13.7)	0.016	1.47 (1.02–5.42)	0.02
≥5	46	(39.3)	3.83 (1.13–14.3)	0.015	1.6 (1.07–3.94)	0.03
Test for effect†						0.012
Gestational age at booking	≤24 weeks		3.00 (1.54–5.90)	0.0029	1.72 (1.24–3.91)	0.01
25–40 weeks*	71	(44.9)	1.0			
Test for effect†						0.0003
ITN use	No*		1.0			
Yes	34	(23.1)	3.10 (1.47–5.72)	<0.001	2.03 (1.13–3.26)	0.04
Test for effect†						<0.001

Notes: OR, odds ratio; CI, confidence interval; ITN, insecticide-treated net.

*Referent category.

†Mantel-Haenszel test with 1 degree of freedom.

‡Crude OR=odds ratio at bivariate level.

§Adjusted OR=en bloc adjustment for age group, educational level, no. of pregnancies, gestational age at booking, and ITN use.

women that booked in the second trimester were more likely to adhere to IPTp compared to those that booked later. Finally, women that used ITN had a twofold increased likelihood to adhere to IPTp compared to non-users.

Discussion

The high awareness and fair knowledge of IPTp is an improvement over a previous report²³ but similar to the report from PHC facilities in south west Nigeria.¹⁸ It is however, a far cry from the findings in Tanzania²⁴ where most of the women were not only aware but knowledgeable about IPT. Our findings are also at variance with the recent NDHS survey.²⁵ Some of these disparities could be explained by variations in literacy levels, methodology, or timing of the studies. The differences that we report could also reflect decision-making processes and health care seeking behavior of target populations.

The distance, means of transport, and time taken to arrive at the antenatal clinic varied widely, but were comparable with reports from other centers.¹⁸ This is a reflection of geographical access to primary health care services in this densely populated urban area. These factors, especially the cost of transportation for those living at a distance from clinics could hinder clinic attendance, leading to missed opportunities for IPTp among other preventive services. One would have expected that primigravida who are inexperienced and at higher risk of malaria and anemia would constitute the majority of clinic attendees; paradoxically however, they constituted just a tenth of the attendees. In contrast, however, the next high-risk group, grandmultiparous women (>5 pregnancies) were well represented at this clinic (nearly 40%). The low attendance of primigravida may not be unconnected with cultural practices in this setting whereby girls are expected to be 'shy' and delivered at their parents' homes under the care of their experienced mothers or grandmothers, who may not be keen on antenatal attendance.²⁶ Of programmatic importance is the high proportion of late booking for antenatal care seen in this study. A mere 3% of respondents registered in the first semester of their index pregnancy. While the majority booked in the second trimester, more than a third booked in the third trimester. Late booking, especially in the third trimester, automatically attenuates the time available for administering the required two doses of IPTp drugs and indeed other preventive strategies. This situation is aggravated by low ITN use, as observed in other centers.¹⁹

Akinleye *et al.*¹⁸ reported increasing uptake of IPTp with increasing parity (up to the third pregnancy), but no association between IPTp uptake and respondent age. In this study, however, we found

that older maternal age (≥ 20 years), multiparity, secondary school or higher level of education, and ITN use were associated with greater adherence to IPTp. These findings are not entirely unexpected, as maternal age and parity are correlated with level of knowledge and experience on issues related to pregnancy. In addition, as discussed earlier, primigravida in this study had lower levels of antenatal clinic utilization, a necessary prerequisite for access to IPTp services. Mothers who use insecticide-treated bed nets are also more likely to be exposed to educational programs on the adverse effects of malaria in pregnancy and therefore more prone to accepting IPTp. These results highlight the need to prioritize targeting primigravida, especially those of lower educational attainment in ongoing efforts to increase uptake and adherence to IPTp.

The concern of some women about taking drugs during pregnancy is understandable, but when they refuse to take IPTp drugs under direct supervision of health care workers, insisting that they need to obtain the expressed permission of their husbands implies a lack of trust and suspicion. The latter may have been fueled by previous rumors related to alleged fortification of vaccines with antifertility drugs. Focus of earlier family planning programs on population control also did not help matters. Health information and communication strategies should be developed to address these apprehensions. Our findings underscore the importance of partner involvement in strategies for improving maternal health. The provision of potable water and disposable cups could address the anxiety of women who rightly refuse to share the same drinking cup with other antenatal clinic attendees for health reasons.

The low adherence to IPTp in this study (36.8%) is consistent with national estimates¹⁷ and with rates reported from other parts of Nigeria.^{18,19} Facility-based studies in other African countries reported adherence rates of 52.3 and 32% in Uganda and the Gambia, respectively.^{27,28} Compared to roll back malaria coverage target of 80% for 2010, countrywide surveys in Africa have shown IPTp two dose coverage ranging from as low as 1% in Benin republic to 70% in Zambia.¹⁷ These variations may be due to health system and individual patient factors, such as availability of IPTp drugs, public attitudes to preventive services and health care seeking behaviors, female literacy, antenatal attendance rates, and attitudes of health care workers. The reasons adduced by respondents in this study point towards health system issues (drug stock outs, and lack of disposable cups and water), and cultural factors (wanting to get permission of husband before taking drugs). It is of particular concern that the advantage of high antenatal clinic attendance is attenuated by missed

opportunities for directly observed uptake of doses of IPTp drugs.

The inverse relationship between the level of adherence to IPTp and gestational age at booking is not surprising, and has been reported by others.²⁹ Early booking provides time for antenatal health education about malaria and other preventive strategies. It also provides an adequate time interval to comply with the required doses of IPTp drugs. The increased experience among women with higher parity could also explain their higher adherence rate observed in this study. The role of education in facilitating understanding of health messages may underpin the effect of educational attainment on adherence, as shown among our respondents. Education is known to affect health seeking behavior.³⁰ Once women appreciate the dangers posed by malaria to their health and that of their unborn babies, they are more likely to adhere to IPTp and adopt other malaria control strategies, such as the use of ITN. It is therefore not surprising that ITN use was also significantly associated with adherence to IPTp.

In addition to IPTp, pregnant women are also encouraged to take iron/folic acid supplements during their pregnancy. Compared to these supplements, IPTp is a more recent concept. It is therefore not surprising that in Sub-Saharan Africa, the uptake of iron/folate supplements by pregnant women is more prevalent than use of IPTp.³¹ Titaley *et al.*³¹ also showed that the benefit of iron/folic acid supplements in preventing neonatal death was maximized when women took both iron/folic acid supplements and antimalarial prophylaxis during pregnancy. Unfortunately in this study we are unable to comment on use of iron, folic acid, and multivitamins in our sample, as our survey did not include questions on iron, folic acid, and multivitamin supplementation.

This study had other limitations. First, due to the cross-sectional nature of our study, pregnant women were not followed up to assess the broader understanding of adherence as full recommended IPTp uptake (of at least two doses of SP or equivalent during second and third trimesters). We assessed what was expected at that stage of pregnancy. Secondly, this study was conducted in only three PHC facilities in urban Kano. It may therefore, not reflect the IPTp practices in rural PHC facilities or other parts of northern Nigeria due to differences in staffing, logistic support, and availability of SP drugs. Finally, the self-reported adherence to IPTp may be affected by social desirability bias. However, the use of female research assistants who were not responsible for IPTp in the study area and the assurance of continued care could have reduced their effects.

In conclusion, we report low levels of adherence to IPTp among women in Kano, Nigeria, 2 years after the target date for the roll back malaria program and 3 years to the Millennium Development Goals target date. Health system factors, including demand and supply sides contributed to low uptake and adherence to IPTp. Strategies to overcome these challenges should include health system strengthening through community mobilization, male partner involvement, and use of innovative alternative IPT delivery channels, including community-based distribution systems and other home-based methods that would bypass cultural barriers to accessing women. These should be supplemented by ITN use and prompt case management.

References

- 1 UN Inter-agency Group for Child Mortality Estimation. Levels and trends in child mortality: report 2010. http://www.childinfo.org/files/Child_Mortality_Report_2011.pdf (accessed 27 June 2012).
- 2 Olusola BO. National Malaria Control Program in Nigeria: 2005 annual report. Abuja: Federal Ministry of Health; 2005. p. 51–5.
- 3 Antoine K. Overview of malaria in West Africa, Lagos Nigeria. WHO Newslett. 2001;1:23.
- 4 Piper C, Brabin BJ, Alpers MP. Higher risk of post-partum hemorrhage in malarious than in non-malarious areas of Papua New Guinea. *Int J Gynaecol Obstet.* 2001;72:77–78.
- 5 Uddenfeldt Wort U, Hastings I, Bergstrom S, Massawe S, Lipingu C, Brabin BJ. Increased postpartum blood loss in pregnancies associated with placental malaria. *Int J Gynaecol Obstet.* 2007;96:171–5.
- 6 Desai M, ter Kuile FO, Nosten F, McGready R, Asamoia K, Brabin B, *et al.* Epidemiology and burden of malaria in pregnancy. *Lancet Infect Dis.* 2007;7:93–104.
- 7 Uneke CJ. Impact of placental Plasmodium falciparum malaria on pregnancy and perinatal outcome in sub-Saharan Africa: I: introduction to placental malaria. *Yale J Biol Med.* 2007;80:39–50.
- 8 Adam I, Elhassan EM, Mohammed AA, Salih MM, Elbashir MI. Malaria and preeclampsia in an area with unstable malaria transmission in Central Sudan. *Malar J.* 2011;10:258.
- 9 Okwa OO. The status of malaria among pregnant women: a study in Lagos, Nigeria. *Afr J Reprod Health.* 2003;7:77–83.
- 10 Agboghroma OC, Elegba OY, Ladipo OP, Umezulike AC, Eftie RE, Tabansi S. Prevalence of asymptomatic malaria parasitaemia in pregnant women at first antenatal visit in Abuja. *Trop J Obstet Gynaecol.* 2004;21:S36.
- 11 Gajida AU, Iliyasu Z, Zoakah AI. Malaria among antenatal clients attending primary health care facilities in Kano state, Nigeria. *Ann Afr Med.* 2010;9:188–93.
- 12 Federal Ministry of Health, Nigeria (FMOH). National guidelines and strategies for malaria prevention and control during pregnancy. A publication of the Federal Ministry of Health, Nigeria; Malaria Control Programme. Abuja: FMOH; 2005.
- 13 Okonofua PE. Prevention of malaria in pregnancy, an important public health challenge. *J Biomed Sci.* 2004;3:15–6.
- 14 Umeh UA, Obi SN, Onah HE, Ugwu EO, Ajah LO, Umeh CR, *et al.* The impact of intermittent preventive treatment with sulphadoxine-pyrimethamine on the prevalence of malaria parasitaemia in pregnancy. *Trop Doct.* 2012;42:133–5.
- 15 Steketee RW, Wirima JJ, Hightower AW. The effect of malaria and malaria prevention in pregnancy on off-spring birthweight, prematurity and intra-uterine growth retardation in rural Malawi. *Am J Trop Med Hyg.* 1996;55:33–41.
- 16 Asa OO, Onayade AA, Fatusi AO, Ijadunola KT, Abiona TC. Efficacy of intermittent preventive treatment of malaria with sulphadoxine-pyrimethamine in preventing anaemia in pregnancy among Nigerian women. *Matern Child Health J.* 2008;12:692–98.
- 17 Brieger W. Control of malaria in pregnancy: an elusive target. *Afr Health.* 2012;34:15–8.

- 18 Akinleye SO, Falade CO, Ajayi IO. Knowledge and utilization of intermittent preventive treatment for malaria among pregnant women attending antenatal clinics in primary health care centers in rural southwest, Nigeria: a cross-sectional study. *BMC Pregnancy Childbirth*. 2009;9:28.
- 19 Nduka FO, Nwosu E, Oguariri RM. Evaluation of the effectiveness and compliance of IPTp in the control of malaria in pregnant women in southeastern Nigeria. *Ann Trop Med Parasitol*. 2011;105:599–605.
- 20 National Population Commission (NPC). Legal notice on publication of the details of the breakdown of the national and state provisional totals 2006 census. Abuja: Federal Republic of Nigeria Official Gazette; 2007. Vol. 94, p. 178–98.
- 21 Lwanga S, Lemeshow S. Sample size determination in health studies: a practical manual. Geneva: World Health Organization; 1991. p. 23–41.
- 22 Mubyazi A, Bloch P, Kamugisha M, Kituua A, Ijimba J.
 - 1 Iliyasu Z, Aliyu MH, Abubakar IS, Galadanci HS. Sexual and reproductive health communication between mothers and their adolescent daughters in northern Nigeria. *Health Care Women Int*. 2012;33:138–52. Intermittent preventive treatment of malaria during pregnancy: a qualitative study of knowledge, attitudes and practices of district health managers, antenatal care staff and pregnant women in Korogwe district, Northern eastern Tanzania. *Malar J*. 2005;4:31.
 - 23 Galadanci HS, Ejembi CL, Iliyasu Z, Alagh B, Umar US. Maternal health in northern Nigeria—a far cry from ideal. *Br J Obstet Gynaecol*. 2007;114:448–52.
 - 24 Gross K, Alba S, Schellenberg J, Kessy F, Mayumana I, Obrist B. The combined effect of determinants on coverage of intermittent preventive treatment of malaria during pregnancy in Kilombero Valley, Tanzania. *Malar J*. 2011;10:140.
- 25 National Population Commission & ORC Macro. Demographic and Health Survey (NDHS). Calverton, MD: NDHS; 2009.
- 26 Iliyasu Z, Aliyu MH, Abubakar IS, Galadanci HS. Sexual and reproductive health communication between mothers and their adolescent daughters in northern Nigeria. *Health Care Women Int*. 2012;33:138–52.
- 27 Brabin L, Stokes E, Dumbaya I, Owens S. Rural Gambian women's reliance on health workers to deliver S-P as recommended intermittent preventive treatment for malaria in pregnancy. *Malar J*. 2009;8:25.
- 28 Ndyomugenyi R, Katamanywa J. Intermittent preventive treatment of malaria in pregnancy (IPTp): do frequent antenatal care visits ensure access and compliance to IPTp in Ugandan rural communities? *Trans R Soc Trop Med Hyg*. 2010;104:536–40.
- 29 Van Eijk AM, Ayisi JG, ter Kuile FO, Slutsker L, Otieno JA, Misore AO, *et al.* Implementation of intermittent preventive treatment with sulphadoxine-pyrimethamine for control of malaria in pregnancy in Kisumu, western Kenya. *Trop Med Int Health*. 2004;9:630–7.
- 30 Launiala A, Honkasalo ML. Ethnographic study of factors influencing compliance to intermittent preventive treatment of malaria during pregnancy among Yao women in rural Malawi. *Trans R Soc Trop Med Hyg*. 2007;101:980–9.
- 31 Titaley CR, Dibley MJ, Roberts CL, Agho K. Combined iron/folic acid supplements and malaria prophylaxis reduce neonatal mortality in 19 sub-Saharan African countries. *Am J Clin Nutr*. 2010;92:235–43.