Malaria Burden Among Pregnant Women Living in the Rural District of Boromo, Burkina Faso

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Abstract. In two cross-sectional surveys carried out in the rural health district of Boromo, Burkina Faso, malaria infection was evaluated in 295 pregnant women in May 2003 and 288 pregnant women in December 2003. Malaria prevalence, all P. falciparum infection, was higher in December (32.2%) than in May (11.9%) (P < 0.0001). In both surveys primigravidae had a significantly higher risk of infection than multigravidae (P < 0.0001). Such risk decreased significantly and progressively with gestational age, the highest risk being during the first trimester. Women who had not attended the antenatal clinic had also a significantly higher risk of malaria infection. Despite the high antenatal clinic attendance and the use (or misuse) of chloroquine chemoprophylaxis, malaria remains an important problem for pregnant women living in the rural district of Boromo. This requires a major effort by the health authorities to guarantee all pregnant women have access to and use preventive measures.

INTRODUCTION

Malaria during pregnancy is a major public health problem; it increases the risk of low birth weight (LBW) (< 2500 g), infant mortality and morbidity during the first year of life by inducing intra-uterine growth retardation, prematurity, and infant anemia. In malaria-endemic countries, placental malaria is associated with a 2-fold higher risk of stillbirth and is responsible for up to 35% of preventable LBW, the most important cause of infant mortality. Malaria infection in pregnancy is associated with a perinatal mortality rate about 25 to 80 per 1000 and probably causes between 75,000 and 200,000 infant deaths each year.

The prevalence of malaria is higher during pregnancy compared with the non-pregnant state. Susceptibility to infection and the severity of clinical manifestations are determined by the level of pre-pregnancy immunity, which in turn, depends largely on the intensity and stability of malaria transmission. In areas of stable malaria transmission, such as Burkina Faso where the most common species is Plasmodium falciparum, most infections are asymptomatic and usually persist for long periods at low densities. Malaria infection (peripheral or placental) is more frequent in primigravidae and secundigravidae than in multigravidae. However, multigravidae persist for long periods at low densities. Malaria infection and mortality during pregnancy is associated with a perinatal mortality rate about 25 to 80 per 1000 and probably causes between 75,000 and 200,000 infant deaths each year. The peak prevalence of P. falciparum parasitaemia is between 9 and 16 weeks of gestation and decreases later toward delivery to pre-pregnancy levels. As incidence rates remain uniform, such changes are probably due to a decrease in post-infection recovery rate during early pregnancy, leading to persistent parasitaemia.

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Malaria burden in pregnant women was estimated in Boromo, a rural district in Burkina Faso, prior to the implementation of a larger study on the effectiveness of sulfadoxine-pyrimethamine (SP) intermittent preventive treatment (IPT) in pregnancy.

METHODS

Two cross-sectional surveys, one in May and the other in December 2003, were carried out in Boromo Health District, western Burkina Faso. The climate is characterized by a rainy season from June to October (average rainfall: 1000 mm per year; mean temperature > 25°C), a cold dry season from November to February (minimum temperature = 15°C), and a hot dry season from March to May when temperatures are often above 30°C. Malaria is holo-endemic with a seasonal transmission from June to December. The region of Boromo is a tropical savannah area populated mainly by subsistence farmers belonging to several ethnic groups. In 2003, its population was estimated at 198,921. There is a district hospital (Centre Médical avec Antenne chirurgicale, CMA) located in Boromo town and 27 health centers (Centre de Santé et de Promotion Sociale, CSPS) in the larger villages. The official policy for malaria and anemia prevention during pregnancy consists of a curative dose of chloroquine (CQ) (1500 mg for 3 days) followed by a weekly dose of 500 mg and daily ferrous sulfate (200 mg) and folic acid (0.25 mg). Since 2003, routine antenatal clinic (ANC) services are free of charge (ANC card, physical examination, including blood pressure measurement, anemia/malaria preventive drugs), whereas urine tests, gloves, and curative drugs should be paid for. HIV prevalence among pregnant women is probably comparable to national figures (4%). There are no data on CQ and SP resistance in Boromo. However, for the period 1998 to 2002, median CQ treatment failure (follow-up 14 days post treatment) in Burkina Faso was 18% (range 12–23) and median SP treatment failure 0.3%. The surveys were carried out in the catchment’s areas of 12 health centers (total population of about 75,000) selected for the SP IPT effectiveness study. In May, 3 villages per health center were randomly selected from the complete list of villages within the 12 health centers catchment’s areas and, within each village, 8 pregnant women were identified by visiting contiguous compounds from a randomly selected starting point. In December, 36 clusters of 8 pregnant women were selected in villages chosen
by probability proportional to size, the largest villages having up to 3 clusters. Oral informed consent was obtained from each study subject. Ethical approval and authorization was obtained from the Ethical Committee of the Institute of Tropical Medicine, Antwerp and the Burkina Faso Ministry of Health.

A structured questionnaire was administered to all selected women. (Questionnaires used for the two surveys were slightly different.) The information collected was divided into 3 sections:

1. Demography and socio-economic status (e.g., age, woman’s education, religion, ethnic group, fundraising activity, husband’s profession and education)
2. Previous pregnancies (parity, child survival, last delivery)
3. Current pregnancy (gestational age according to the woman’s estimation, ANC attendance or reasons for non-attendance, use of malaria/anemia preventive drugs and of other drugs).

Female interviewers, fluent in Dioula, the most common local language, and French, pre-tested and translated the questionnaire during their training for the survey. All selected pregnant women had their axillary temperature taken by an electronic thermometer. A blood sample for parasitemia (thick and thin blood film) and packed cell volume (PCV) was collected, the latter only during the December survey.

Blood slides were stained with 10% Giemsa solution for 10 min. The number of asexual P. falciparum parasites per 200 white blood cells (WBC) was determined on thick film and the parasite density per μl was computed assuming a mean WBC count of 8000/μL. A slide was considered negative if no asexual form was found after counting 500 WBC. All slides were read twice and discrepant results checked by one of us (SOC). PCV was measured by microhematocrit centrifugation.

Data were double-entered and validated using Epi Info 2000 (Centers for Disease Control, Atlanta, Revision 1, Nov. 2002). χ²-test or Fisher’s exact test were used to compare proportions for categorical variables. Means were computed and compared by analysis of variance (ANOVA). The mean parasite densities were compared by computing the geometric mean and compared by computing the geometric means. Results were considered to be significant when the 2-sided P value was < 0.05.

RESULTS

Five hundred eighty three pregnant women were identified and included in the two surveys, 295 in May and 288 in December 2003. In both surveys pregnant women had similar characteristics, except for a previous delivery in a health facility, higher in December than in May (Table 1). Most women were married, with a low education level (< 20% had attended any school) and about half of them lived within 5 km from a health facility. About 20% of them were primigravidae and a similar percentage secundigravidae. Obstetric wastage (miscarriage and stillbirth) was particularly high and among secundigravidae and multigravidae, about half had lost at least one live born child (Table 1).

Attendance to ANC was high; at the time of the survey more than 60% of the women [64.4% (190/295) in May and 61.5% (177/288) in December] had already attended at least once, 47.4% (174/367) of them twice or more, with no difference according to parity. Most women (216/263, 82.1%) in the third trimester had attended the ANC at least once. Secundigravidae (67/118, 56.8%) were more likely to have delivered their previous baby in a health facility than multigravidae (147/343, 42.9%) (P = 0.01). Among those who had already attended the ANC, more than half (234/367, 63.8%) had CQ and ferrous sulphate tablets at home, though during the December survey 27.5% (28/102) of women who had attended the ANC within the previous month did not have any CQ left.

Malaria prevalence, all infections P. falciparum, was significantly higher in December (93/288, 32.2%) than in May (35/295, 11.9%) (OR: 3.54, 95% CI: 2.2–5.58) (P < 0.0001). In both surveys primigravidae (May: 15/27, 26%; December: 34/60, 56.7%) [(May: OR: 5.1, 95% CI: 2.2–11.8; P < 0.001) (December: OR: 5.2, 95% CI: 2.7–9.7; P < 0.0001)] had a significantly higher risk of infection than multigravidae (May: 12/184, 6.5%; December: 35/173, 20.2%) whereas for secundigravidae (May: 8/54, 14.8%; December: 24/55, 43.6%) this was true only for the December survey (OR: 3.1, 95% CI: 1.6–5.8; P = 0.001). Mean parasite density decreased by parity, with the primigravidae having the highest (P = 0.05) (Table 2). In the December survey 15.1% (14/93) of women with peripheral parasitemia had fever whereas among non-parasiticemic women the prevalence of fever was 6.2% (12/194).

In both surveys, the risk of malaria infection decreased significantly and progressively with gestational age, the highest risk being during the first trimester [(May: first trimester 7/30, 23.3%, OR 3.63; second trimester 16/110, 14.5%, OR 2.0; third trimester 12/155, 7.7%, 1.0; test for trend P = 0.008) (December: first trimester 19/34, 55.9%, OR 3.99; second trimester 48/146, 32.9%; OR 1.54, third trimester 26/108, 24.1%, 1.0; test for trend P = 0.001)]. Such difference is maintained even after stratifying by parity (test for trend for both surveys,
Indeed, the assessment of the gestational age was

P < 0.0001. Pregnant women

However, in May more than 20% of women in the first trimester were infected, indicating that some transmission should have occurred during the dry months, even when allowing 1 month error in the estimation of gestational age. An additional factor contributing to such a high prevalence at the end of the dry season could be the increasing CQ resistance, already observed in Burkina Faso26 (Coulibaly SO, personal communication). However, the lower prevalence of malaria infection in women who had already attended the ANC indicates that weekly CQ in this setting may still have an impact. A comparable prevalence of malaria infection among pregnant women has been reported from another district in Burkina Faso though, contrary to our findings, CQ prophylaxis did not have any impact on malaria prevalence.27 The methods used to select the study subjects (i.e., at the ANC or at community level) might explain such a difference.

Primi- and secundigravidae had a higher prevalence of infection and a higher mean parasite density, confirming previous observations that in areas of stable malaria these two groups are the most vulnerable.14,21,28,29 Despite the higher prevalence of infection at the end of the transmission season, the higher risk in women of lower parity was observed also at the end of the dry season, when transmission should be extremely low or absent. Therefore, in areas of seasonal malaria, infection during pregnancy is not only limited to the period of high transmission; rather it affects women throughout the year, even when transmission is thought to be low or absent.

The prevalence of malaria infection was higher during the first trimester and decreased steadily during the second and third trimester. Such a pattern was observed in both surveys. This is consistent with the observation that the peak prevalence of *P. falciparum* infection is between 9 and 16 weeks of gestation.23 Indeed, the assessment of the gestational age was done according to the information provided by the women themselves and cannot be considered as extremely accurate. However, according to the data collected in a later survey, when the uterine height was compared with the gestational age as estimated by the women recruited, the majority of those in the second and third trimester correctly estimated it; half of the women estimating to be in the first trimester were correct whereas the rest was at the beginning of the second trimester (S. Gies, personal communication). Therefore, most women identified at the surveys during their first trimester of pregnancy probably fall into the period of 9 and 16 weeks of gestation. Despite the imprecision of their estimation, women believing to be in the first trimester of pregnancy will not attend the ANC for several weeks. A large proportion of them would have an unrecognized and untreated malaria infection, which will have an important impact on their health and on the health of their offspring. Assuming an early attendance to the ANC and considering that most infections are asymptomatic, at least half of them will not receive SP IPT because this is advised to be given after quickening, which usually occurs at about 13 to 16 weeks of gestation, in primigravidae up to 18 to 20 weeks of gestation.20 Therefore, their infection will go untreated until the next ANC visit. This might be a problem for countries implementing SP IPT, including Burkina Faso, which has recently decided on this approach. Pregnant women in the first trimester could be systematically screened for malaria infection, possibly with rapid diagnostic tests, and adequately treated.

Anemia was common and associated with malaria infec-

\[ P = 0.01. \] Women who had not attended the ANC [May: 23.8% (25/105); December: 49.5% (55/111)] had a significantly higher risk for malaria infection ([May: OR: 5.6, 95% CI 2.6–12.3, \( P < 0.0001 \)); (December: OR: 3.57, 95% CI 2.1–6.0, \( P < 0.0001 \))], even after controlling for parity ([May: OR: 6.7, 95% CI 3.0–15.0, \( P < 0.0001 \)); (December: OR: 5.3, 95% CI 2.9–9.6, \( P < 0.0001 \))] or trimester ([May: OR: 4.9, 95% CI 2.1–11.2, \( P = 0.0001 \)); (December: OR: 3.4, 95% CI 1.8–6.4, \( P = 0.0001 \)). Bed net use was low (66/583, 11.3%) with no major differences between surveys. The percentage of bed nets treated with insecticide was 9% (6/66). There was no difference in malaria prevalence between women using or not using bed nets.

In December PCV was measured in all women. Anemia (PCV <33) was observed in 48.3% of women, mostly mild (PCV: 30–32) (25.3%) or moderate anemia (PCV: 21–29) (22.6%), severe anemia (PCV: ≤20) being rare (0.3%). The mean PCV was 32.8% (SD = 4.3) with a significant difference according to parity (primigravidae 30.5, secundigravidae 32.6 and multigravidae 33.6, \( P < 0.0001 \)). Pregnant women with malaria infection had a significantly lower PCV (31.6 versus 33.3) (\( P = 0.002 \)), though such a difference was mainly due to the difference in primigravidae (29.4 versus 31.9) (\( P = 0.01 \)) and secundigravidae (31.4 versus 33.6) (\( P = 0.04 \)). Mean PCV among women in their third pregnancy or more did not differ according to malaria infection (33.9 versus 33.6) (\( P = 0.6 \)).

### DISCUSSION

In Boromo District, malaria infection was frequent among pregnant women, higher at the end of the transmission season in December, but still substantial in May, just before the rains started. Because transmission is highly seasonal, and much lower between January and June than in July and December, it is likely that most women were infected during the previous transmission season and were unable to clear their infections.1 However, in May more than 20% of women in the first trimester were infected, indicating that some transmission should have occurred during the dry months, even when allowing 1 month error in the estimation of gestational age. An additional factor contributing to such a high prevalence at the end of the dry season could be the increasing CQ resistance, already observed in Burkina Faso26 (Coulibaly SO, personal communication). However, the lower prevalence of malaria infection in women who had already attended the ANC indicates that weekly CQ in this setting may still have an impact. A comparable prevalence of malaria infection among pregnant women has been reported from another district in Burkina Faso though, contrary to our findings, CQ prophylaxis did not have any impact on malaria prevalence.27 The methods used to select the study subjects (i.e., at the ANC or at community level) might explain such a difference.

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### Table 2

<table>
<thead>
<tr>
<th></th>
<th>May 2003 N = 295 (%)</th>
<th>December 2003 N = 288 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primigravidae</td>
<td>15/57 (26.9)</td>
<td>34/60 (56.7)</td>
</tr>
<tr>
<td>Secundigravidae</td>
<td>8/54 (14.8)</td>
<td>24/55 (43.6)</td>
</tr>
<tr>
<td>Multigravidae</td>
<td>12/184 (6.5)</td>
<td>35/173 (20.2)</td>
</tr>
<tr>
<td>Total</td>
<td>35 (11.9)</td>
<td>93 (32.2)</td>
</tr>
<tr>
<td>First trimester</td>
<td>7/30 (23.3)</td>
<td>19/34 (55.9)</td>
</tr>
<tr>
<td>Second trimester</td>
<td>16/110 (14.5)</td>
<td>48/146 (32.9)</td>
</tr>
<tr>
<td>Third trimester</td>
<td>12/155 (7.7)</td>
<td>26/108 (24.1)</td>
</tr>
<tr>
<td>Mean (geometric parasite density/μl)</td>
<td>373</td>
<td>474</td>
</tr>
<tr>
<td>Primigravidae</td>
<td>624</td>
<td>1119</td>
</tr>
<tr>
<td>Secundigravidae</td>
<td>185</td>
<td>629</td>
</tr>
<tr>
<td>Multigravidae</td>
<td>312</td>
<td>169</td>
</tr>
<tr>
<td>Anemia (PCV &lt;33%)</td>
<td>139 (48.3)</td>
<td>55/111 (49.5)</td>
</tr>
<tr>
<td>Mild (PCV 30–32)</td>
<td>73 (25.3)</td>
<td>65 (22.6)</td>
</tr>
<tr>
<td>Moderate (PCV 21–29)</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>Severe (PCV ≤20)</td>
<td></td>
<td>1 (0.3)</td>
</tr>
<tr>
<td>No attendance to ANC</td>
<td>25/105 (23.8)</td>
<td>55/111 (49.5)</td>
</tr>
<tr>
<td>Bed net use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No net</td>
<td>33/269 (12.3)</td>
<td>82/248 (33.1)</td>
</tr>
<tr>
<td>Regular use</td>
<td>2/26 (7.7)</td>
<td>11/40 (27.5)</td>
</tr>
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</table>

*ANC: antenatal clinic.*
tion, particularly in primi- and secundigravidae. The prevalence is similar to that observed in malaria endemic countries, particularly in Africa. However, the prevalence of severe anemia was lower than in other studies. Obviously, malaria infection is an important cause of anemia in primi- and secundigravidae and successful malaria control interventions should be able to decrease the burden.

Antenatal clinic attendance was high and similar to that found in other districts. It should be considered that this is an underestimation because selected women were at different trimesters of gestation. Indeed, most women in the third trimester had attended the ANC at least once. Moreover, most women could show they have CQ tablets at home, indicating that they had received the required chemoprophylaxis at the ANC. However, it is impossible to know whether this was taken correctly and at the required time. Indeed, during the December survey, at the time of malaria transmission, a substantial proportion of women should have had CQ at home but were unable to show it. This might indicate that women do not necessarily use the drugs received for their chemoprophylaxis but according to their family needs. Despite these shortcomings, ANC attendance seems to decrease the risk of malaria infection, possibly due to the partial use of weekly CQ.

As expected, most infected women did not have fever at the time of the survey, an observation consistent with pre-existing antimalarial immunity, partially effective during pregnancy. In these settings, it is difficult to identify infected pregnant women and this is a major problem for infections occurring at the end of the first trimester, a time when SP IPT may not be given if before quickening.

The surveys were not designed to detect an association between malaria infection and reproductive wastage. Nevertheless, in an area of such high transmission, the contribution of malaria to the burden of miscarriages and stillbirths might be substantial. Moreover, the information we collected indicates a high rate of infant and childhood mortality because half of the secund- and multigravidae selected for the survey had lost at least one live born child. Despite the difficulty of establishing its causes, malaria is probably a major contributor to this situation because it is the first cause of childhood mortality in Burkina Faso.

In conclusion, despite the high attendance to ANC and the use (or misuse) of CQ chemoprophylaxis, malaria remains an important problem for pregnant women living in the rural district of Boromo. It is unclear whether the recent change from CQ weekly to SP IPT (not operational yet) will be able to have a major impact on the health of these women. The new strategy will definitely not solve the problem of malaria infection during the first trimester because SP is advised to be given after quickening, at about 13 to 16 weeks of gestation. In addition, the other major intervention targeted to pregnant women (i.e., insecticide-treated bed nets) has not been scaled up, with barely one tenth of women using untreated ones. Such situation requires a major effort by the health authorities to guarantee that preventive measures will be easily accessible to all pregnant women.

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