Malaria during Pregnancy

Pregnant women form a high risk group for malaria infection which may cause abortions, still births and premature labour. Malaria in pregnancy is a significant health problem in India and requires systematic studies. Almost all the published literature on the topic refers to Africa, which presents data referring principally to *Plasmodium falciparum*—the commonest cause of infection. We examined the relationship between malaria infection and pregnancy in central India. This region is of special interest because the population is exposed to both *P. vivax* and *P. falciparum* infections.

Epidemiology of Malaria in Pregnancy

A study was carried out in collaboration with the Government Medical College, Jabalpur, which caters to mixed rural, tribal and urban population (Singh *et al* 1999). A malaria clinic was established at the hospital to examine pregnant women for malaria. Analysis of three years data showed significantly higher ($p<0.001$) malaria prevalence among pregnant women, especially primigravid than non-pregnant women. Mean parasite densities were significantly higher in pregnant women compared to non-pregnant women for both *P. falciparum* ($p<0.001$; df = 137) and *P. vivax* ($p<0.05$; df = 72) infections. Pregnant women with falciparum or vivax malaria were significantly more anaemic than non-infected pregnant women or infected non-pregnant women (Table 4). Cerebral malaria was a common complication of severe *P. falciparum* infection, with a high mortality rate during pregnancy.

The average weight of 155 neonates from infected mothers was 350 g less than that of 175 neonates from non-infected mothers. This difference in birth weight was statistically significant for both *P. falciparum* ($p<0.0001$; df = 278) and *P. vivax* ($p<0.0001$; df = 223) infection. Congenital malaria was not recorded.

In an another study during malaria epidemic (Singh *et al* 2001) among 151 malaria infected pregnant women, *P. falciparum* was the predominant species (88%) with highest prevalence in II trimester (59.4%) irrespective of parity status. About 3% abortions, 3.7% stillbirths and 2.2% neonatal deaths were documented in *P. falciparum* infected women. Out of six cases examined, three of these samples (1 *Pv*; 2 *Pf*) showed evidence of placental infection. The proportion of low birth weight babies was also significantly higher among those born to infected women than those born to the non-infected (95.2% vs 68%; $\chi^2 = 13.09$; df = 1; $p<0.01$). Four neonates died before Day 20 post-partum—three born to multigravidae infected with *P. falciparum* and one to an apparently uninfected second gravida.

A study was also done to evaluate the efficacy

Table 4. Malaria parasitaemia, anaemia during pregnancy and low birth weight babies/neonates among the study subjects in central India

	All cases[a]	Cases with *P. vivax* infection	Cases with *P. falciparum* infection	Control 1[a]	Control 2[a]
No. tested	2127	365	365	1984	
No. selected	365 (17%)	121 (33%)	244 (67%)	150 (8%)	1762 (i.e. 2127-365)
Pregnant	Yes	Yes	Yes	Yes	Yes
Fever	Yes	Yes	Yes	Yes	Yes
Malaria	Yes	Yes	Yes	Yes	No
No. with Hb data available	271 (74%)	83 (69%)	188 (77%)	85 (57%)	88 (5%)
Mean Hb ± SD (g/dl)	–	9.05 ± 1.39	6.42 ± 1.98	9.68 ± 1.43	10.03 ± 1.11
No. with birth weight available	155 (42%)	50 (41%)	105 (43%)	–	175 (10%)
Mean wt ± SD (kg)	2.18 ± 0.25	2.22 ± 0.30	2.15 ± 0.21	–	2.53 ± 0.43

[a]Women cases with fever; Control 1— Infected non-pregnant women; Control 2—Non-infected pregnant women.

of CQ (25 mg/kg body weight) in the treatment of *P. falciparum* in pregnant women in a malaria meso-endemic area of District Mandla (Singh *et al* 2001). Out of 21 positive patients enrolled, six (28.6%) women (2 primi + 4 multi) had a RIII type response (95% C.I. 9–48%), one (4.7%) multigravida showed partial response (RI early/RII). Remaining (66.7%) women (3 primi + 11 multi) had a late RI/S type of response. Thus, the cumulative failure rate in this study was 95% (95%C.I. 86.13–100%). The 13 women (2 primi + 11 multi) who did not respond and were treated again with CQ, 10 (1 primi + 9 multi) failed (77%) again (95% C.I. 48–95%) on Day 28 and 35.

To evaluate the feasibility of delivering malaria chemoprophylaxis to pregnant women in urban settings of District Jabalpur, 155 pregnant women were enrolled of which 100 were with malaria and 55 without malaria. Out of 100, 27 were *P. vivax* (parasitaemia ranged from 1025–19,700 parasites/µl) and 73 were *P. falciparum* (1175–35,000 parasites/µl) (Singh *et al* 2002). The results revealed that the chemoprophylaxis to pregnant women was possible only in 30 patients (19.3%)—20 with malaria and 10 without malaria. None of these women developed malaria during the study period. Average birth weight of 11 babies born to women with malaria was 2.41 ± 0.21 kg and of the five babies born to women without malaria was 2.48 ± 0.2 kg. This difference was not statistically significant. Studies showed that there is limited understanding of the drug policy at district level and even if the drugs are prescribed for chemoprophylaxis, the compliance among pregnant women for the same is poor.

Evaluation of a Rapid Diagnostic Test for Assessing the Burden of Malaria at Delivery

Plasmodium falciparum sequester in placenta, it is very difficult to assess the true burden of diseases without the examination of placenta after delivery. Therefore, we used rapid diagnostic tests (RDTs) for on the spot diagnosis and treatment.

All pregnant women who came for delivery at a district hospital in Mandla and a civil hospital in Maihar were screened for *P. falciparum* (placental parasitaemia using a rapid test and microscopy and peripheral and umbilical cord parasitaemia using microscopy alone). Two rapid diagnostic tests (RDTs), ParaCheck *Pf* and ParaHITf, were used. At Mandla, the sensitivity and specificity of the ParaCheck *Pf* for *P. falciparum* were 93 and 84%, respectively. The positive predictive values (PPVs) and negative predictive values (NPVs) were 50 and 99%, respectively. At Maihar, the sensitivity and specificity of the ParaHITf for *P. falciparum* were 87.5 and 97%, respectively. The PPVs and NPVs were 75.4 and 98.7%, respectively. Placental infection was significantly associated with low birth weight. The RDTs for the identification of *P. falciparum* were more sensitive in placental blood than the placental blood smear by microscopy. Thus, the RDTs should be useful for rapid assessment of malaria at delivery.

We also organized training workshops on malaria in pregnancy for national and international programme managers. The first workshop was conducted at Jabalpur in 2004 for four southeast Asian countries, i.e. Bangladesh, Myanmar, Indonesia and India with the financial assistance of WHO and technical assistance of CDC. Subsequently, WR India provided funds for conducting four workshops in the state. These were carried out in Jabalpur, Katni, Satna and Bhopal for bringing awareness to policy makers and programme managers. Additionally, "Burden of malaria in pregnancy" is being assessed in Jharkhand and Chhattisgarh states with the financial assistance of USAID, Washington and ICMR, New Delhi in collaboration with US investigators. The study is in progress.

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