Plasmodium/intestinal Helminth Co-infections among Pregnant Nigerian Women

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Hospital based studies were conducted to investigate the occurrence of Plasmodium*/intestinal helminth co-infections among pregnant Nigerian women, and their effects on birthweights, anaemia and spleen size. From 2,104 near-term pregnant women examined, 816 (38.8%) were found to be infected with malaria parasites. Among the 816 parasitaemic subjects, 394 (48.3%) were also infected with intestinal helminths, 102 (12.5%) having mixed helminth infections. The prevalence of the helminth species found in stool samples of parasitaemic subjects examined was,* Ascaris lumbricoides *(19.1%), hookworm (14.2%),* Trichuris trichiura *(7%)* Schistosoma mansoni *(3.4%),* Enterobius vermicularis *(2%),* Hymenolepis *sp. (1.6%) and* Taenia *sp. (1%). Mothers with* Plasmodium *infection but without intestinal helminth infection had neonates of higher mean birthweights than those presenting both* Plasmodium *and intestinal helminth infections and this effect was more pronounced in primigravids. The mean haemoglobin values of malarial mothers with intestinal helminth infections were lower than those with* Plasmodium *infection but without intestinal helminth infections but these were not statistically significant. Severe splenomegaly was predominant among parasitaemic gravidae who also harboured* S. mansoni *infection in two of the hospitals studied.*

Key words: *Plasmodium* - intestinal helminths - pregnant women - haemoglobin values - Nigeria

In sub-saharan Africa up to 24 million women may become pregnant each year (Bundy et al. 1995). This high rate is often related to an increase in the susceptibility of pregnant women to infections because pregnancy is a time of high hormone activity which may exert immuno-suppressive effects (Beer & Billingham 1978, McGregor et al. 1983) on the child bearing woman.

Plasmodium infection is a very common occurrence in Africa and several studies have reported the relationship between malaria during pregnancy and low birthweight anaemia, splenomegaly and congenital transmission (Jilly 1969, McGregor et al. 1983, Brabin 1991, Egwunyenga et al. 1996, 1997).

In Nigeria, although *Plasmodium* infection is generally more prevalent, the occurrence of intestinal helminth infections is also high and hookworm infections and ascariasis, have been associated with iron deficiency anaemia (Obiamiwe 1977, Nwosu 1981, Udonsi 1984, Migasena & Gilles 1987, Obiamiwe & Nmorsi 1991). The hookworm infection prevalence among pregnant women in subsahara in Africa for instance has been estimated to be 32% (Bundy et al. 1995). Given the high fertility rate, low nutritional status and poor hygiene conditions predominant in developing societies, intestinal helminth infections during pregnancy may contribute significantly to the degree of anaemia in pregnant women.

The concomittal occurrence of *Plasmodium* and intestinal helminth infections in pregnant women in Nigeria, their clinical manifestations and the association of the infections are largely unreported. This study investigates the prevalence and some clinical effects of malaria infection in pregnant women co-infected with intestinal helminths.

MATERIALS AND METHODS

Subjects - The subjects were randomly selected near-term pregnant women who delivered at the University of Jos Teaching Hospital, Jos, Plateau State; Bauchi Specialist Hospital, Bauchi State and Eku Baptist Hospital, Eku Delta State, between 1st February 1997 and 31st January 1998. From the 2,104 pregnant women screened in cross sectional survey for malaria infection, 816 were found to be infected with malaria parasites and selected for further studies. The women are Nigerians representing the predominant ethnic groups of the area studied. Personal data of subjects relating to age, par-

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ity, residence and toilet facilities were obtained with the assistance and cooperation of the hospital staff. The majority of subjects reside in high density urban areas with inadequate waste disposal facilities. The staple food of subjects are rice, cassava, maize and yam. The weight and sex of the newborn on delivery as taken by the midwife were also recorded. Only live and singleton births were included in the study.

Blood examination - Thick and thin films were made from collected blood samples and stained by Field and Giemsa techniques, employing the methods of Cheesbrough (1988). Parasite densities were estimated by counting trophozoites concomitantly with white blood cells (wbc) in each field and recording positive smears as the ratio of trophozoites per wbc. The number of trophozoites per 200 wbc was then multiplied by the average wbc count of maternal blood (Larkin & Thuma 1991). The thin blood films were examined first with 40x objective to identity the *Plasmodium* species.

The haemoglobin concentration was evaluated using iron determination technique (Toro & Ackerman 1975). Differences in mean haemoglobin values between *Plasmodium* infected mothers with and without intestinal helminth infections were tested for statistical significance using chi square (χ^2) analysis (2 x 2 contingency tables).

Stool samples were collected from each of the 816 near-term pregnant women who tested positive for malaria infection, concentrated employing the formaldehyde-ether method (Cheesbrough 1988), and examined microscopically within 24 h of collection to identify helminth ova present.

Spleen examination - Spleen examination by palpation was carried out on all 816 study women to feel the tip of the spleen by pressing the abdomen under the coastal border (Bruce-Chwatt 1985). The degree of enlargement of the spleen was determined and classified from 0 indicating normal spleen, to 5 indicating very enlarged spleen, palpable beyond the symphysis pubis (Hackett 1944). The percentage enlarged spleen was then determined from data collected. Differences in percentage enlarged spleen among malaria parasitaemic gravidas with and without intestinal schistosomiasis were tested for statistical significance by chi (χ^2) analysis (2 x 2 contingency tables).

RESULTS

Of the 2,104 near-term pregnant women examined, 816 (38.8%) were infected with malaria parasites; 762 (36.2%) with *P. falciparum* and 54 (2.6%) with *P. malariae*. Of the 816 malaria parasitaemic subjects, 394 (48.3%) were infected with intestinal helminths; 102 (12.5%) presenting mixed infections, consisting mainly of *Ascaris lumbricoides*, hookworm and *Trichuris trichiura*. The prevalence of the seven helminths found in their stool samples were hookworm (14.3%), *A. lumbricoides* (19.1%), *T. trichiura (*7%), *Schistosoma mansoni* (3.4%) *Enterobius vermicularis* (2%) and *Taenia* sp. (1%) (Table I). Hookworm and *A. lumbricoides* infections were the predominant helminth infections accounting for over 69% of all helminths recorded. The total prevalence of helminth infections by area of residence was 55.3% in Bauchi, 44.8% in Jos and 45.4% in Eku.

The occurrence of intestinal helminth infections in malaria parasitaemic pregnant women was found to have effect on the birthweight of neonates on delivery. This was found by grouping mean birthweights of mothers with intestinal helminth infections separately from those without intestinal helminths (Table II). The results indicated that mothers infected with malaria parasites but with-

TABLE I

Prevalence of intestinal helminth infections in *Plasmodium* positive near-term pregnant women

	Bauchi (300) [a]		Jos (228)		Eku (218)		Overall (816)	
Helminth	No. infected	% prevalence	No. infected	% prevalence	No. infected	% prevalence	No. infected	% prevalence
Hookworm	49	16.3	33	11.5	34	15.6	116	14.3
Ascaris lumbricoides	77	25.8	52	18.1	27	12.4	156	19.1
Trichiuris Trichiura	19	6.3	23	8	15	6.9	57	7
Schistosoma mansoni	13	4.3	15	5.2	0	0	28	3.4
Enterobius vermicularis	4	1.3	3	1	9	4.1	16	2
Taenia sp.	0	0	1	0.4	7	3.2	8	1
Hymenolepis sp.	4	1.3	2	0.7	7	3.2	13	16
Total	166	55.3	129	44.8	99	45.4	394	48.3

a: number of subjects in parenthesis

TABLE II

Mean birthweights of newborns of *Plasmodium* positive mothers with and without intestinal helminth infection

	Mean birthweights (g ± S.D.)		
	With intestinal helminth infection	Without intestinal helminth infection	Difference
Bauchi			
Primigravidae	2608 ±135	3063 ± 64	455
Multigravidae	2982 ± 161	3141 ± 70	159
Jos			
Primigravidae	2816 ± 152	3134 ± 63	318
Multigraviae	3046 ± 165	3216 ± 72	170
Eku			
Primigravidae	2936 ± 115	3219 ± 35	283
Multigravidae	3238 ± 142	3462 ± 28	224

out intestinal helminth infections had neonates with higher birthweights than those with both *Plasmodium* and intestinal helminth infections. This was more pronounced in primigravid mothers who had higher differences in birthweights than multigravids. The differences among primigravids are 455 g, 318 g and 283 g in Bauchi, Jos and Eku respectively; while among multigravidae, birthweight differences were 150 g, 170 g and 224 g.

Table III illustrates the effects of *Plasmodium*/ intestinal helminth co-infections on mean haemoglogin levels. The mean haemoglobin values of *Plasmodium* infected mothers with intestinal helminth infections were lower than those of malaria positive mothers without intestinal helminth infection, but these differences were not statistically significant ($\chi^2 = -0.18$, df = 5, $P > 0.05$).

The study also indicates that the occurrence of the highest spleen class (5) was significantly more frequent ($\chi^2 = 66.54$, df 5, $P < 0.05$) among *Plasmodium* infected gravida who also harboured *S. mansoni* infection in Jos and Bauchi. This is shown as spleen class in relation to malaria positive mothers with and without *S. mansoni* infection (Table IV). In Bauchi, 120 of the 185 *Plasmodium* positive mothers had no palpable spleen; all 120 (100%) had no *S. mansoni* infection. Only 2 (5%) out of 40 subjects with moderate splenomegaly (spleen class 1-4) had *S. mansoni* infection. This contrasts with the 64% prevalence (16 out of 25) of subjects with intestinal *Schistosoma* infection in the group with the largest spleen (class 5). The higher occurrence of *S. mansoni* infection among splenomegalic malaria positive subjects is more apparent in Jos, where 75% of malaria positive gravidae with the largest spleen (class 5) also suffer from *S. mansoni* infection. No *S. mansoni* infection was detected among pregnant women screened in Eku.

TABLE III

Mean haemoglobin (g/dl ± S.D) of *Plasmodium* positive mothers with and without helminth infection

	Mean haemoglobin (g/dl ± S.D.) of *Plasmodium* positive mothers	
	With intestinal helminth infection	Without intestinal helminth infection
Bauchi		
Primigravidae	8.6 ±13	9.7 ± 1.5
Multigravidae	8.9 ± 1.6	10.1 ± 1.2
Jos		
Primigravidae	8.6 ± 1.5	10.3 ± 1.4
Multigraviae	9.8 ± 0.9	10.5 ± 1.2
Eku		
Primigravidae	9.9 ±1.3	8.9 ± 1.9
Multigravidae	10.5 ± 1.6	10.5 ± 1.6

TABLE IV

Spleen in relation to *Plasmodium* positive women with and without *Schistosoma* infection

Spleen class		*Plasmodium* positive women	
(Hacket classification)	n	No. (%) *S. mansoni* + ve	No. (%) *S. mansoni* - ve
Bauchi			
0	120	0 (0)	120 (100)
1-4	40	2 (5)	38 (95)
5	25	16 (64)	9 (36)
Jos			
0	180	0 (0)	180 (100)
1-4	18	3 (16.7)	15 (83.3)
5	16	12 (75)	4 (25)
Eku			
0	48	0 (0)	48 (100)
1-4	10	0 (0)	10 (100)
5	4	0 (0)	4 (100)

DISCUSSION

This study has demonstrated that over 45% of *Plasmodium* infected near-term pregnant women on antenatal care also harbour various intestinal helminths. The occurrence of helminth infection at high rates among pregnant women is indicative of faecal pollution of soil and domestic water supply around homes due to poor sanitation and improper sewage disposal. Studies in many parts of Nigeria (Odutan 1974, Obiamiwe 1977, Nwosu 1981, Udonsi 1984, Holland et al. 1989, Obiamiwe & Nmorsi 1991) have highlighted the hyperendemicity of soil-transmitted helminths, especially among children. Maternal women are at high risk of infection because of their close relationship with children.

The findings of this study with respect to birthweights suggest that the already reported influence of *Plasmodium* infection during pregnancy on birthweights (Brabin 1991) may be aggravated by helminth infections. Women are usually more susceptible to malaria infection in the first pregnancy, and there is an important association between malaria infection during pregnancy and newborn with low birthweight. Low birthweight newborns present poor immunity and increased susceptibility to infections in childhood (Harrison & Ibeziako 1973, Chandra 1988).

The low level of splenomegaly among individuals with *S. mansoni* infection suggests that intestinal schistosomiasis is not a major contributor to this morbidity in the area studied. Conversely *Plasmodium* infection should be considered as the major cause of splennomoegaly since over 80% of all cases of spleen enlargement were among subjects with *Plasmodium* infection.

Pregnant women with *Plasmodium*/intestinal helminth co-infections (especially primigravids) had lower haemoglobin levels than those who suffered only from malaria infection (Table III). Reduced mean haemoglobin levels are attributed to chronic loss of blood and iron. The most important cause of pathological chronic loss of blood and iron in the tropics is hookworm and other soil-transmitted helminths (Migasena & Gilles 1987), and malaria in pregnancy (Fleming 1982). *Plasmodium*/intestinal helminth co-infections anaemia in pregnancy is aggravated by low nutritional status of subjects whose staple foods, such as rice, cassava, and maize are poor sources of folate, and iron (Metz et al. 1970, Huq et al. 1983).

Treatment of anaemia in pregnancy involves antimalaria drugs, as well as iron and folate supplement (Fleming 1982). Since helminth infections may increase anaemia in *Plasmodium* infected gravidae, treatment in these women should, in addition to antimalaria drugs, and iron/folate supplements, include antihelminth drugs, especially in areas where the incidence of geo-helminth infections is high.

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