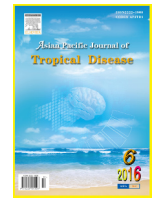




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Pattern of *Plasmodium*-intestinal helminth co-infection among pregnant women in a high transmission zone of malaria in Nigeria

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ABSTRACT

Objective: To investigate the co-infection of malaria and intestinal helminths and its burden among the pregnant women in Kwara State, Nigeria.

Methods: Blood and faecal samples of pregnant women were randomly examined using blood smear and Kato-Katz techniques, respectively. Micro-haematocrit reader was used to estimate packed cell volume (PCV) while information concerning pregnancy and transmission factors was obtained by questionnaire.

Results: Out of the 300 pregnant women, 17.3% had at least one parasite infection and the specific rate of co-infection was 73.1%. Co-infection of *Plasmodium falciparum* and *Ascaris lumbricoides* decreased with increasing age while the concurrence of *Plasmodium falciparum* with hookworm increased with increasing age of women. It was observed that helminth infection protected the severity of malaria and aggravated anaemia level. Pregnant women with malaria alone had average parasitaemia of 1034.9 parasite/μL of blood and PCV of 30.24% while individuals co-infected with hookworms had parasitaemia of 859.67 parasite/μL and PCV of 26.98%. Our findings also indicated that the prevalence of infection in pregnancy varied with gestation periods. The highest prevalence was recorded in pregnant women in their primigravidae and first trimester. Inadequate toilet facilities, illiteracy, occupations, low incomes and proximities of vegetation around the habitation were observed to influence the transmission of multiple parasites.

Conclusions: Mass drug administration and maintenance of personal and environmental hygiene are essential preventive measures in endemic communities to ward off the debilitating effects of parasites in pregnancy.

1. Introduction

Pregnancy-associated malaria results in substantial maternal and fetal morbidity, causing 75 000–200 000 infant deaths every year. Pregnant women are more susceptible to malaria than non-pregnant women, and the susceptibility is highest in primigravidae

even in low transmission area[1,2]. The susceptibility to malaria during pregnancy has not only been attributed to immunological and hormonal changes associated with pregnancy but also with the unique ability of a subset of infected erythrocytes to sequester in the placenta[3,4].

Extensive evidences confirm the importance of protective antibodies directed against the surface of infected erythrocytes in the placenta of multigravidae, which is usually absent in first pregnancy, leading to adverse pregnancy outcomes, including maternal anaemia, low birthweight, fetal growth restriction splenomegaly and congenital transmission[5].

In sub-Saharan Africa, there exists a broad geographic overlap between *Plasmodium falciparum* (*P. falciparum*) and an intestinal helminth infection due to favorable environmental conditions

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The study protocol was performed according to Helsinki declaration and approved by Kwara state ministry of health and University of Ilorin ethical research committee. Informed written consent was obtained from Chief Medical Officers of each health centres and the consented individual

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and human behavioral activities that enhance the survival and transmission of the parasites[6,7]. The effects of multiple parasite infections in a host have serious public health implications, many of which remain unknown[8]. For instance, existing data suggest that the co-infection of *P. falciparum* and hookworm has an additive impact on hemoglobin; exacerbating anemia-related malaria disease burden in pregnancy[6]. This is a common problem in many developing countries where poverty, ignorance and diseases are more prevalent. It is globally estimated that 58.27 million women are anaemic during pregnancy, and 55.75 million (95.7%) live in developing countries[9].

In Nigeria, epidemiological data on concomitant parasitic infections in pregnant women are largely limited. For effective planning and control programs, appropriate comprehensive data are necessary. We therefore investigate the co-infection of malaria and intestinal helminths and its burden among the pregnant women in Kwara State, Nigeria.

2. Materials and methods

2.1. Description of study areas

The study was conducted among pregnant women attending antenatal care in two health centres (Sobi Specialist Hospital and Ajikobi Cottage Hospital) in Ilorin. Ilorin is located between longitude 08°29'21" E, latitude 04°30'50" N and longitude 08°29'43" E, latitude 04°31'01" N. It has typical tropical climate with well-defined wet (April–October) and dry (November–March) seasons. Inhabitants are predominantly subsistence farmers, with few petty traders and civil servants. The community is mainly made up of Yoruba and Fulani ethnic groups although a small proportion of the people belong to Hausa, Nupe and Ebira ethnic groups. The sanitary condition in many areas of the community is precarious as human and domestic wastes are littered around human habitations and water drainage system is poor. Most of the houses lack protective mosquito nets.

2.2. Data and sample collection

A hospital-based study was conducted on pregnant women between January and June, 2015. After the collection of informed consent forms from volunteers, a pre-tested structured questionnaire was administered to access the bio-demographic and epidemiological factors of the participants. Women were interviewed by one of the investigators (Olarewaju Abdulkareem Babamale) on the possible risk factors. Thereafter, stool and blood samples of each subject were collected in a pre-labelled specimen container and ethylene diamine tetraacetic acid bottle respectively with detailed instruction on hygienic handling of samples. Samples were transported to University of Ilorin Teaching Hospital, Ilorin, Nigeria where parasitological examinations were conducted using blood film and Kato-Katz thick smear techniques

for malaria and intestinal parasites, respectively. Only participants that were positive for malaria were examined for intestinal helminths. The number of parasites per microliter of blood was calculated using Greenwood and Armstrong[10] and stool samples were prepared under microscopy within 1 h after collection. The capillary technique using Hewkley micro-haematocrit reader was used for the estimation of the packed cell volume (PCV).

2.3. Ethical consideration

The study protocol was performed according to the Helsinki Declaration and approved by Kwara State Ministry of Health and University of Ilorin Ethical Research Committee. The informed written consent was obtained from chief medical officers of each health centre and the consented individuals. Participants who were positive for any of the parasites were referred for treatment in the hospital.

2.4. Statistical analysis

All analysis was performed using SPSS version 16.0 for Windows (SPSS Inc. Chicago, IL, USA). Differences in the prevalence and intensity of infections between ages and sexes were tested using the *Chi-square* and One-way ANOVA tests, respectively. Values are considered statistically significant when *P* values were less than 0.05.

3. Results

Out of the 300 pregnant women examined, 52 (17.3%) were positive for at least one parasite species. Overall, 12.7% of our study population recorded multiple parasitic infections. The prevalence of infections according to age groups was comparable but not significant ($P > 0.05$) except for the co-infection of malaria and hookworm ($P = 0.048$). The co-infection of *P. falciparum* and *Ascaris lumbricoides* (*A. lumbricoides*) decreased with increasing age while the concurrence of *P. falciparum* with hookworm increased with increasing age. The infection status with respect to gravidae and parity of the pregnancy revealed that individuals in primigravidae and first trimester showed a significant high prevalence of malaria and intestinal helminths (Table 1).

The infection pattern with respect to PCV and parasitaemia level of *P. falciparum* is similar. The average PCV in uninfected pregnant women was observed to be 40.03% while individuals with malaria alone, malaria + hookworm and malaria with 2 helminth parasites (*A. lumbricoides* + hookworm) recorded an average PCV of 30.24%, 26.98% and 25.32% respectively. Similar trend in PCV was observed with decreasing levels of parasitaemia (Table 2). Analysis of socio-economic and environmental factors of the pregnant women revealed that factors such as lack of toilet facilities, illiteracy, occupations and low/no monthly incomes were the overlapping factors that influenced multiple parasites

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