EPIDEMIOLOGY OF MALARIA IN CHILDREN LIVING AT IGBO-ORA, SOUTH WESTERN NIGERIA*

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Abstract

Malaria transmission is seasonal with higher transmission occurring in the rainy season. The burden of malaria falls mainly on children and causes anaemia and fever. Children of school going age are affected and this leads to absence from school. Blood samples were collected from children aged 10 days to 15 years in dry and rainy seasons. Parasite densities were determined by microscopy. Malaria prevalence was higher in the rainy season than in the dry season. In the dry season, 42.4% of the children studied were positive for *P. falciparum*. While at the end of the rainy season 48.4% of the children were malaria positive. The parasite prevalence was not significantly different between males and females. Parasite densities varied from 18 to 52174 parasites per µl of blood. The most abundant group ranged from 1-100 (59%). There was a significant correlation between parasite density and age with the mean parasite density decreasing with age group. The study shows that malaria is more prevalent in the rainy season, and children in rural areas have high prevalence of asymptomatic parasitemia which might lead to symptomatic malaria. The results show that malaria immunity increases with age in both seasons.

Key words: Malaria, children, parasitemia, *Plasmodium falciparum*, immunity.

1. Introduction

The incidence rate of malaria worldwide is estimated to be 300 to 500 million clinical cases each year, with about 90% of these occurring in Africa, south of the Sahara. Most of these cases are caused by *Plasmodium falciparum* (Meek *et al.*, 2001). It has been stated that most of the children who come to the health centres in Nigeria are treated for malaria (Sule, 2003; Olarewaju and Johnson, 2001; Fawole and Onadeko, 2001, Gellert *et al.*, 1998, Angyo *et al.*, 1996). Also a study by Adediran *et al.*, (2003) showed that 50% of the children admitted to the Obafemi Awolowo teaching hospital children emergency ward that required transfusion had malaria parasitemia. Afolabi, *et al.*, (2001) related the presence of malaria parasites with anaemia in children in the first six months of life, while May *et al.*, (2000) and Lasingu, *et al.*, (2004) showed that the prevalence of anaemia increased with the extent of *P. falciparum* parasitemia. Transplacental transfer of *P. falciparum* to newborn babies was shown by the presence of parasitemia in children within seven days of birth (Egwunyenga *et al.*, 1995). The presence of parasites in cord blood was related to decrease in weight of new born children (Egwunyenga *et al.*, 1996).

Malarial infection was found to be the most common infection among children of school age admitted for fever in an emergency room in Benin City (Akpede and Sykes, 1993). Studies have shown that school children in rural areas have a much higher prevalence of malaria parasite infection than those in the urban areas (Ademowo *et al.*, 1995; Kazadi *et al.*, 2004). Its being suggested that malaria adversely affects the performance of children at school (Fernando *et al.*, 2003). Children with asymptomatic parasitemia have an increased risk of having symptomatic malaria than children who were negative for malaria parasites (Njama-Meya *et al.*, 2004). The aim of this study was to determine the prevalence of asymptomatic malaria in children aged 10 days to 15 years. This involved looking at the influence of season and age on the prevalence of the parasites in the children.

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2. Materials and Methods

Study Area:

Igbo Ora and Idere towns in Ibarapa local government area of Oyo state in south-western Nigeria were chosen as the study site. Three rivers, Opeki, Ofiki and Ayin pass through the area. *Anopheles gambiae* and *A. funestus* are the mosquito species found in this area (Lawrence, 1965). Igbo Ora is about 100 km from Ibadan, the state capital; the majority of the population is Yoruba. The climate consists of a warm dry season (November to March) and a cooler rainy season (April to October). The main occupation of the men is farming and hunting while the women are peasant farmers and retail traders (Achidi *et al.*, 1996).

Study Design:

The cross sectional survey was carried out during the dry season, Jan - Mar 1999 and at the end of the rainy season Oct - Nov 1999. The study protocol was reviewed and approved by the Joint Ethical Committee of the College of Medicine and the University College Hospital, Ibadan. The subjects of the study included infants and children from 10 days to 15 years. 369 and 351 individuals were enrolled in the dry and rainy seasons respectively. Criteria for inclusion into the survey included the age, sex, length of time spent in the study site and informed consent.

Blood Collection:

Blood (1-2 ml) was collected from the subjects by qualified medical doctors. The blood was stored in sample tubes with 0.12 M trisodium citrate and properly labelled. The blood samples were stored in ice, and transported to the Cellular Parasitology Laboratory in Ibadan. The blood samples were centrifuged at 8000 rpm for two minutes in a biofuge table top centrifuge. The plasma obtained from it was stored at -80 °C.

Parasitology:

Thick films were prepared and stained in 10% Giemsa solution in a Wheaton staining jar for 20 minutes and then allowed to dry. The parasites were counted under a microscope using the thick film on the basis of number of parasites per 200 white Blood Cells; this was converted to the number of parasites per µl of blood (WHO, 1985).

Statistical Analysis:

The results were analyzed using correlation, ANOVA and students t test. The levels of significance were estimated at $P < 0.05$ for ANOVA and students t test, while $P < 0.01$ for correlation. The software packages used were Microsoft EXCEL and SPSS.

3. Results

In the dry season the most frequent group sampled were children aged 61-120 months and above (163 of 352), followed by 121-180 months (86 of 351), then 0-6 months (42) and 7-12 months (22), and 13 - 24 months (13), 49 - 60 months (9), finally 25-48 (8). The age of the individuals sampled ranged from one month to 180 months. 45.4% of the samples were male while 54.6% were female. At the end of the rainy season the most frequent group sampled were children aged 61-120 months and above (126 of 370), followed by 25-48 (76), 121-180 months (71), then 0 - 6 months (38), 49-60 months (26) and 7-12 months (12), and 13-24 months (8). The age of the samples ranged from one month to 168 months. 50.5% of the samples were male while 49.5% were female. *P. falciparum* parasitemia was prevalent both in the dry season and at the end of the rainy season (Fig. 1). The incidence rate in the two seasons the samples

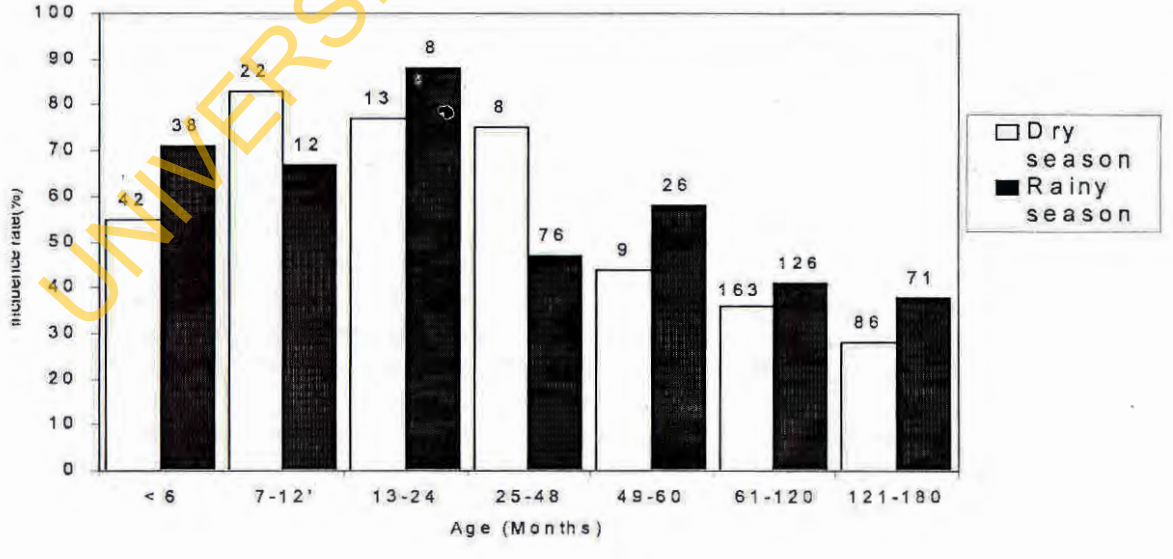

Fig.1: Incidence rates of Malaria in the dry season and at the end of rainy season. The incidence rates of malaria parasitemia among 351 children, 10 days to 15 years old, during the dry season (January to March 1999) and among 369 children with the same age distribution at the end of the rainy season (October to November 1999), at Idere and Igbo Ora rural towns in south-western Nigeria. The incidence rate was calculated as the percentage of malarial parasite-positive individuals. The actual number of samples screened for parasites in each age group is shown at the top of each bar.

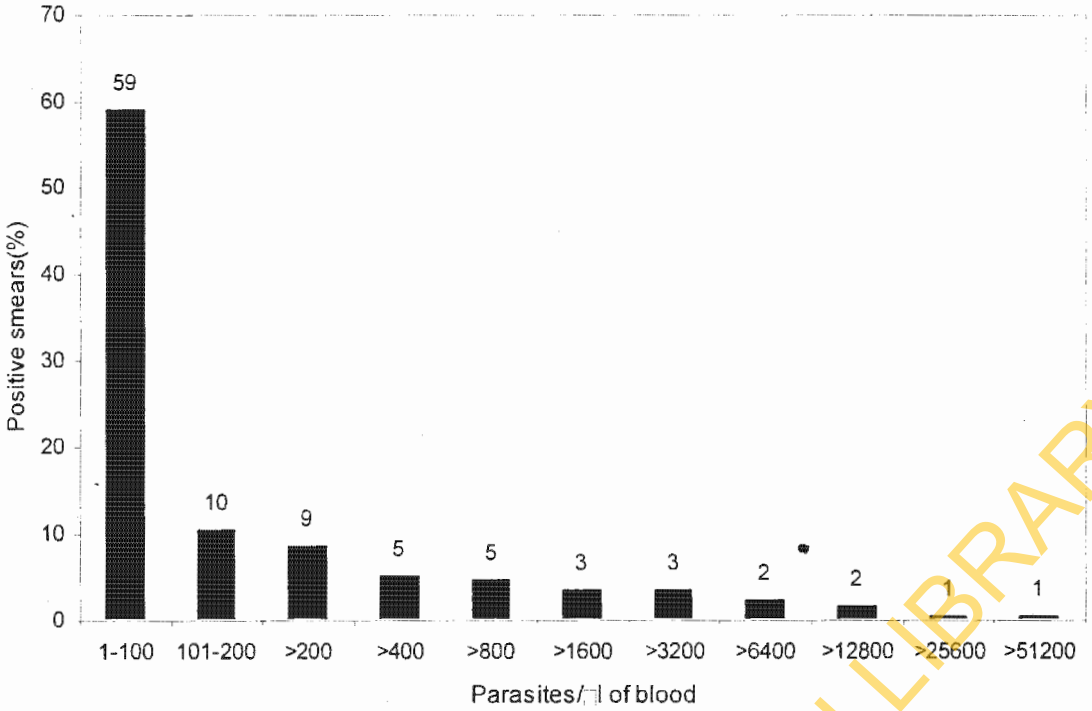

Fig.2: Parasite density classes of malaria positive smears. The number of parasite/200 leukocytes was counted and expressed as the number of parasites in a microlitre of blood. The different density classes were identified and the number of subjects in each class was determined and expressed as percentage of the total number of parasitemic subjects. The number of samples screened for parasites in each density class is shown at the top of each bar. The children were all asymptomatic for malaria.

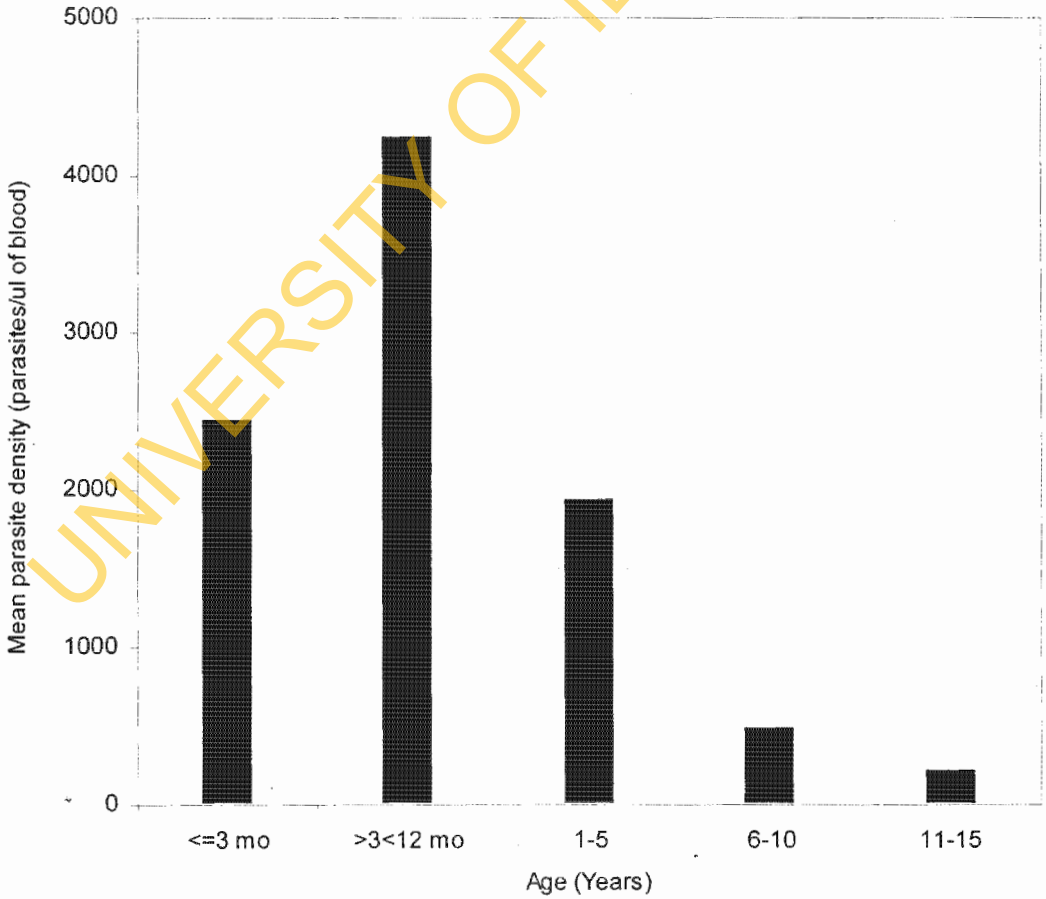

Figure 3: Mean parasite density and age. The relationship between age and parasite density was ined. Age is expressed in years while parasite density is expressed as number of parasites in a microlitre of

were collected showed that there were more individuals positive for *P. falciparum* at the end of the rainy season within the different age groups (except 7-12 and 25-48 months age groups) than in the dry season (Fig. 1). In the dry season malaria prevalence rose from 55% to 83% and fell to 28%. At the end of the rainy season the malaria prevalence rose from 71% to 88% and fell to 38%. The trend of the incidence rate shows that malaria in the dry season peaked at 7-12 months and fell as the children got older, while at the end of the rainy season the malaria incidence peaked at 13-24 months and fell as the age of the children increased (Fig. 1). In the dry season, 42.4% of the individuals studied were positive for *P. falciparum*. At the end of the rainy season 48.4% of the children were malaria positive. In the dry season 42.3% (66) of the males and 42.1% (80) of the females were positive for malaria, while at the end of the rainy season 49.7% (92) of the males and 46.7% (85) of the females were positive for malaria. The children who were recruited for the study were all asymptomatic for malaria; there was no record of any one of them being clinically ill. Parasite densities varied from 18 to 52174 parasites per µl of blood. The most abundant group ranged from 1 - 100 (59%) (Fig. 2). There was a significant correlation ($P > 0.01$. $r_s = -2.48$) between parasite density and age with the mean parasite density decreasing with age group (Fig. 3).

4. Discussion

Epidemiological studies have demonstrated that the burden of morbidity and mortality is concentrated among the youngest age groups under conditions of intense, perennial, stable transmission. The precise relationship between frequencies of parasite exposure, functional immunity and disease risk remains ill defined (Snow *et al.*, 1999). Children living in Igbo - Ora, south western Nigeria, were used in the study. Results from other studies have indicated a high level of exposure in this study area to malaria infection early in life (Achidi *et al.*, 1995). Umar *et al.*, (2002) stated that individuals living in these communities had a malaria morbidity of about 24.4% by looking at hospital data. What we did was to evaluate the number of children with parasitemia, since the children were malaria asymptomatic. The malaria incidence was higher at the end of the rainy season than the dry season (Fig. 1). The results showed that there were more children with parasites in their peripheral blood at the end of the rainy season than in the dry season. This agrees with previous studies carried out by Nwagwu *et al.*, (1998). This was attributed to the increased activity of the disease vector *Anopheles gambiae*, Bradley, (1991) reported that malaria transmission is proportional to mosquito density. Van der Kolk *et al.*, (2003) in a study carried out in Cameroun showed that only *Anopheles gambiae* and *A. funestus* contributed to malaria transmission in their study area and their distribution was seasonal. The main vectors in Igbo - Ora have been reported to be *Anopheles gambiae* and *A. funestus* (Lawrence, 1965).

Results from this study showed that in the dry season the incidence rates increased from about six months of age 7-12 months old before it began to fall. The incidence rates at the end of the rainy season increased from about 6 months of age to 13-24 months before they began to fall. Children aged 121 - 180 months had the least malaria incidence rate in both seasons (Fig.1). A similar age - dependent trend was observed in a study previously carried out in Igbo - Ora (Achidi *et al.*, 1996), who showed that parasite densities in children in their first year of life increased from two to eight months then started to fall. Oyediran et al., (1993) showed that in Igbo - Ora parasitemia decreased after the one to five years age group. The results of this study showed that children less than one year old were infected, and had higher incidence rates than children two to five years old. This could be due to transplacental transfer of the parasites from mother to child. It could also be suggested that as the children grew older they had more frequent exposure to malaria with their immunity increasing, while those that were younger and had less frequent exposure to the parasite had higher parasitemias due to their lower immunity. Parasite density classes of malaria - positive smears showed that 1-100 (59%) parasites class was most frequent (Fig. 2). This correlated with the previous work by Nwagwu *et al.*, (1998), and it implies that most individuals studied had few parasites in their peripheral blood.

This study showed that parasite density decreased significantly with age (Fig. 3) in agreement with the study carried out by Aribot et al., (1996) and Sharma *et al.*, (2004) who showed that malaria prevalence and parasitemia were inversely correlated with age. Al-yaman *et al.*, 1996, showed that the geometric mean of *P. falciparum* density was highest in children less than two years of age. The results from this study show that there was higher malaria incidence in the rainy season than in the dry season. The parasites prevalence in the children is high and this could affect the children's attendance and performance in school. Children living in rural areas, should be screened routinely for parasites and treatment administered as this could help bring down the rate of absenteeism and increase the performance of the children at school. However this study shows that the ability of the children to resist malaria increases as they grow older.

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