

MALARIA IN THE FIRST 6 MONTHS OF LIFE IN URBAN AFRICAN INFANTS WITH ANEMIA

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Abstract. A total of 446 infants in the first 6 months of life who presented at an urban children's hospital with complaints of any illness whatsoever were recruited into a study with the aim of determining the contribution of malaria to infant morbidity in a malaria-endemic urban area in Nigeria. Sixty-eight of the infants were in their first month of life and 79, 77, 61, 97, and 64 were in their second, third, fourth, fifth and sixth month of life, respectively. Overall, 107 (24.0%) infants were clinically diagnosed as having malaria. This included 3 who were in the first month of life, 12 in the second, 15 in the third, 17 in the fourth, 33 in the fifth, and 27 in the sixth months of life (4.4, 15.2, 19.5, 27.9, 34.0, and 42.1%, respectively). Laboratory investigations confirmed 35 (32.7%) of those clinically diagnosed and 86 (25.4%) of those not clinically diagnosed ($n = 339$) as having malaria parasitemia, giving an overall malaria parasite rate of 27.1% among the infants. Acute respiratory infection was the major diagnosis (41.3%) among those that were not initially diagnosed as malaria but turned out to have malaria parasitemia followed by gastroenteritis (11.8%) and failure to growth (1.5%). Overall geometric mean parasite density was 202.5 parasites/ μ L of blood (range, 12–65,317 parasites/ μ L of blood). The mean hematocrit of infants with parasites (33.0%) was significantly lower ($P < 0.005$) than that of infants without parasites (35.1%). The mean hematocrit of infants with malaria parasites in each age group was lower than that of infants without malaria parasites in the corresponding age group. Among the infants with malaria parasites, those aged 2 to 2.9 months recorded the lowest mean hematocrit (30.1%), and those aged < 1 month recorded the highest mean hematocrit (42.7%). Axillary temperature increased and hematocrit decreased with increase in parasite density. The percentage of infants with anemia likewise increased as the parasite density increased. *Plasmodium falciparum* was present in all infected infants, but mixed infection with *P. malariae* was present in only 2.5% of infections. Analysis of our data suggests an urgent need for health education of caretakers and for training of clinicians for increased awareness of malaria as an important cause of illness and anemia in infants aged < 6 months so as to reduce children's wasting due to an easily preventable and treatable disease.

INTRODUCTION

Deaths from malaria in Africa occur mainly in children aged 6 months to 5 years and result almost entirely from the severe and complicated forms of the disease.¹ Infants aged < 6 months are believed to be relatively immune. In early studies conducted in West Africa, malaria was found less frequently in infants aged < 6 months old than in older children.^{2–7} When it occurred, it was less severe and was not a major cause of mortality. Clinical attacks are said to be rare in the first few months of life,⁸ and severe attacks are believed to be more likely to develop between the ages of 9 months and 2 years.⁹

These old observations formed the basis of the current belief that in the malaria-holoendemic countries of West Africa, severe malaria is a problem only after the age of 6 months. However, anecdotal accounts suggest contrary evidence that severe forms of clinical malaria might in fact be more frequent at age of ≤ 6 months.¹⁰ Since the early studies, there have been rapid urbanization, change in lifestyle, increased complexity of social structures, extensive population movements, and environmental changes that could lead to changes in the epidemiological picture. In view of these—particularly the fact that reports of malaria in children aged < 6 months are becoming more frequent—we thought it useful to undertake a reexamination of the malaria situation in infants aged ≤ 6 months in different epidemiological situations in the country. Here, we describe the situation in an urban area of Nigeria.

SUBJECTS AND METHODS

Study area. The study was undertaken at the Massey Street Children's Hospital, which is located in a high-density

area of Lagos City that is deficient in amenities such as satisfactory refuse disposal, pipe-borne water supply, and environmental sanitation. The hospital draws its patients from a population of about 2 million, out of a total of 7.5 million, for Lagos.¹¹ Although it is designated as a second-tier facility, this hospital serves as a primary-care facility and is the first point of contact for most patients seeking medical care. The hospital also receives patients referred from surrounding primary health care clinics and hospitals in both the public and private sectors.

Study population. A total of 446 consecutively presented infants aged ≤ 6 months who were reported to be ill at the hospital between April 1996 and March 1997 were recruited into the study. Inclusion criteria were age ≤ 6 months and informed consent from the parent or guardian. Infants with congenital abnormalities and those who were hospitalized were excluded. Of these 446 infants, 401 (89.9%) initially presented to the hospital, and the rest were referred, including 3 from a facility that cared for abandoned babies. The hospital sees children > 6 months of age, and during the time of this study, a total of 2,117 children aged ≤ 72 months were seen, among whom 446 were aged ≤ 6 months. All the infants were outpatients who were brought in because their caregivers considered them to be ill, and they were examined for malaria parasites and other clinical parameters.

Ethical considerations. The ethical committees of the Nigerian Institute of Medical Research, Yaba, Lagos, and the Lagos State Health Management Board gave approval for the study. Mothers or guardians were assured of the confidentiality of the results, and only infants whose caregivers provided consent were included in the study.

Procedures. Each infant was subjected to full clinical ex-

TABLE 1
Characteristics of infants in the study

Characteristic	Age group (months)						All
	≤1	1.1-2	2.1-3	3.1-4	4.1-5	5.1-6	
Number	68	77	79	61	95	66	446
Sex							
Male	41	42	49	37	45	41	255
Female	27	35	30	24	50	25	191
Age (months)							
Mean	0.57	1.52	2.45	3.53	4.50	5.55	3.05
± Standard deviation	0.27	0.28	0.30	0.25	0.27	0.30	1.70
Minimum	0.03	1.02	2.00	3.02	4.01	5.00	0.03
Maximum	0.99	1.97	2.99	3.94	4.99	5.98	5.98
Weight (kg)							
Mean	3.28	4.18	5.14	6.14	6.36	6.82	5.34
± Standard deviation	0.69	0.28	0.94	0.98	1.39	1.15	1.61
Minimum	1.70	2.00	2.50	4.40	3.20	4.10	1.70
Maximum	4.90	6.10	7.00	8.20	9.30	9.40	9.40
Weight-for-age Z score							
Mean	-0.87	-0.54	-0.23	-0.03	-0.32	-0.57	-0.42
± Standard deviation	1.20	1.15	1.13	1.06	1.44	1.17	1.24
Minimum	-3.59	-3.60	-3.47	-1.97	-3.77	-3.11	-3.77
Maximum	2.16	2.16	2.22	2.27	2.41	1.94	2.41

amination. In particular, jaundice, pallor, and liver and splenic enlargement were carefully looked for and noted. Axillary temperature was measured with a mercury thermometer (a 1-min stabilization time was used) and recorded. Clinical diagnosis was made by the outpatient medical officer before referring the patient to the research physician, who then proceeded to obtain fingerprick blood from the patient for examination for malaria parasite and determination of hematocrit. Each child was weighed naked, and its sex and date of birth was noted. Pyrexia was defined as temperature of ≥ 37.5°C. Anemia^{12,13} was defined as hematocrit < 33% and severe anemia¹⁴ as hematocrit < 20%. Clinical jaundice was defined as yellowness of the sclera.

Laboratory diagnosis of malaria parasitemia. Thick and thin blood films were prepared on the same slide for each infant. The slides were stained with buffered Giemsa stain and examined under a microscope at ×700 magnification under oil immersion. The thin films were examined for species identification of parasites, and the thick films were used to determine parasite density. This was done by counting the number of asexual parasites against 200 leukocytes in a Giemsa-stained thick-film preparation and calculating parasite density per microliter of blood by multi-

plying by a factor of 6,000. Four hundred fields were examined and certified to contain no parasites before a slide was declared negative.

Data analysis. Data collected were entered into an IBM-compatible PC with Epi Info version 6 (CDC, Atlanta, GA) statistical software. Analysis carried out included frequency of proportions, bivariate (cross-tabulation), and multivariate regression analysis, adjusting for possible confounders. Results were expressed as mean (± standard deviation [SD]). Statistical differences between means were determined by Student's *t*-test when comparing 2 groups or by analysis of variance of repeated measurements when comparing > 2 situations. Level of significance was taken as *P* < 0.05.

RESULTS

General characteristics of the patients. The 446 infants comprised 255 boys and 191 girls. Table 1 shows their age, weight, and sex distribution. Table 2 shows diagnosis at presentation according to age. The most frequent clinical diagnosis was acute respiratory infection, which occurred in 42.8% infants, followed by malaria in 24%, diarrhea in 13%, and skin rashes in 9%. Malaria was only 4.4% of all illnesses

TABLE 2
Frequency table of illnesses diagnosed at presentation according to age

Diagnosis	Age group (months), n (%)						Total (n = 446)
	≤1 (n = 68)	1.1-2 (n = 77)	2.1-3 (n = 79)	3.1-4 (n = 61)	4.1-5 (n = 95)	5.1-6 (n = 66)	
Acute respiratory infection	6 (23.5)	32 (41.6)	31 (39.2)	33 (54.1)	40 (42.1)	33 (50.0)	185 (41.5)
Malaria	3 (4.4)	12 (15.6)	15 (19.0)	17 (27.9)	32 (33.7)	28 (42.4)	107 (24.0)
Gastroenteritis	5 (7.4)	6 (7.8)	11 (13.9)	8 (13.1)	16 (16.8)	9 (13.6)	55 (12.3)
Skin rash	0 (0.0)	0 (0.0)	1 (1.3)	0 (0.0)	4 (4.2)	2 (3.0)	7 (1.6)
Failure to grow	10 (14.7)	33 (42.9)	11 (13.9)	9 (14.8)	0 (0.0)	9 (13.6)	72 (16.1)
Septicemia	11 (16.2)	8 (10.4)	1 (1.3)	1 (1.6)	0 (0.0)	0 (0.0)	20 (4.5)

TABLE 3
Profile of clinical diagnosis and laboratory confirmation of malaria according to the age group of the infants studied

Variable	Age group (months)						Total
	≤1	1.1-2	2.1-3	3.1-4	4.1-5	5.1-6	
Total number diagnosed as malaria, <i>n</i>	3	12	15	17	33	27	107
Number (from <i>n</i>) confirmed microscopically as malaria cases	0	5	8	10	11	1	35
Total number not diagnosed as malaria, <i>nd</i>	65	67	62	44	64	37	339
Total number (from <i>nd</i>) confirmed microscopically as malaria cases	12	16	17	13	18	10	86
Total number of slides positive for malaria	12	21	25	23	29	11	121
Total number with <i>Plasmodium falciparum</i>	12	21	25	23	29	11	121
Total number with <i>Plasmodium malariae</i>	1	0	0	0	2	0	3
Geometric mean parasite density (GMPD) (parasites/μL of blood)	101	230	149	280	231	170	202
Minimum PD (parasites/μL of blood)	23	35	12	34	23	23	12
Maximum PD (parasites/μL of blood)	690	16,507	3,882	65,317	19,964	1,690	65,317

diagnosed in the first month of life. This rose steadily for each month of life thereafter, reaching a maximum of 42.4% in the sixth month of life. Other diagnosis occurring at low frequency were conjunctivitis (*n* = 8; 2%), oral thrush (*n* = 7; 2%), hydrocele (*n* = 5; 1%), otitis media (*n* = 4; 1%), and tetanus (*n* = 3; 1%). Childhood-immunizable diseases such as tuberculosis, diphtheria, and pertussis were relatively rare (< 1%). All the subjects were still being breast-fed except for 5, aged < 1 month to 3 months, whose mothers died soon after delivery and 3 aged 5 to 6 months from the abandoned babies' facility. Because active immunization program was being vigorously pursued in the area, 398 (89%) subjects had received pertinent immunization. The remaining 48 children had not received any immunization because their parents had only recently arrived in the area.

Presentation of illness, clinical diagnosis, and microscopic confirmation of malaria parasitemia. Thirteen percent of malaria-attributable morbidity corresponded to axillary temperature of < 37.5°C. Table 3 presents the distribution, by age, of the 107 infants diagnosed clinically with malaria. Among these, 3 were aged 1 month, 12 aged 2 months, 15 aged 3 months, 17 aged 4 months, 33 aged 5 months, and 27 aged 6 months. However, microscopic examination of the blood slides revealed that malaria parasite was present in only 35 of these 107 children. The age distribution of these 35 is as follows: 0 in infants aged < 1 month, and 5 (42%), 8 (53%), 10 (59%), 11 (33%), and 1 (4%) in those aged 2, 3, 4, 5, and 6 months, respectively. Thus, in our study, compared with malaria confirmation by

microscopy, the sensitivity of malaria diagnosis in infants is 32.7%, specificity 74.6%, positive predictive value 28.9%, and negative predictive value 77.8%.

At first contact, all 107 children presented with fever, and physical examination did not reveal any localizing signs so that other causes of pyrexia in infants, in particular acute respiratory infection (upper and lower), enteritis, and measles were excluded. There was no difference between the parasite-positive and parasite-negative groups in their clinical presentation. Reexamination of the parasite-negative patients did not reveal any other cause of the illness. They were therefore assumed to have malaria and were treated accordingly.

Table 3 also presents the distribution, by age, of the 339 infants who were not diagnosed clinically as having malaria but in whom microscopic examination of the blood film showed malaria parasitemia in 86 children.

Clinical findings. Table 4 shows the clinical findings according to the age of 121 infants with malaria parasitemia. Anemia was the most common morbidity associated with malaria parasitemia. The prevalence of anemia associated with malaria parasitemia ranged from 2.9% among those in the first month of life to 19.0% in those in the third month of life. This was followed by pyrexia (body temperature ≥ 37.5°C), which occurred most in the fourth month of life (6.6%) and least in the first (1.5%) and sixth (1.5%) months of life, respectively. The prevalence of splenomegaly was higher (4.6%) than that of hepatomegaly (3.3%) or that of hepatosplenomegaly (3.3%), which were found more in the

TABLE 4
Clinical findings according to age group of 121 children with malaria parasitemia

Clinical findings	Age group (months), <i>n</i> (%)					
	≤1 (<i>n</i> = 68)	1.1-2 (<i>n</i> = 77)	2.1-3 (<i>n</i> = 79)	3.1-4 (<i>n</i> = 61)	4.1-5 (<i>n</i> = 95)	5.1-6 (<i>n</i> = 66)
Jaundice	1 (1.5)	1 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.5)
Anemia (hematocrit < 33%)	2 (2.9)	10 (13.0)	15 (19.0)	9 (14.8)	14 (14.7)	6 (9.1)
Pyrexia (temperature ≥ 37.5°C)	1 (1.5)	5 (6.5)	2 (2.5)	4 (6.6)	5 (5.3)	1 (1.5)
Hepatomegaly	0 (0.0)	1 (1.3)	1 (1.3)	2 (3.3)	1 (1.1)	2 (3.0)
Splenomegaly	0 (0.0)	0 (0.0)	1 (1.3)	3 (4.9)	2 (2.1)	1 (1.5)
Hepatosplenomegaly	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.3)	1 (1.1)	1 (1.5)

TABLE 5
Mean hematocrit of infants with and without malaria parasitemia relative to their ages

Age group (months)	With parasites		Without parasites		P value
	Frequency	Mean hematocrit (%)	Frequency	Mean hematocrit (%)	
≤1	12	42.7	56	42.6	0.97
1.1–2.0	20	33.3	57	35.2	0.21
2.1–3.0	26	30.1	53	33.1	0.01
3.1–4.0	23	32.1	38	32.5	0.76
4.1–5.0	29	32.2	66	32.8	0.48
5.1–6.0	11	32.6	55	33.7	0.46
All subjects	121	33.0	325	35.1	0.003

fourth month of life. The prevalence of jaundice did not rise above 1.5% in any age group. Other findings of neonates with malaria parasitemia included symptoms of central nervous system irritation (5 of 12, 41.7%), symptoms of acute respiratory infection (3 of 12, 25.0%), symptoms of gastrointestinal disturbance (4 of 12, 33.3%), rashes (2 of 12, 16.7%), and eye discharge (2 of 12, 16.7%).

Malaria parasitemia and organomegaly in infants. Also shown in Table 4 is the age distribution of malaria-infected children with splenomegaly ($n = 7$), hepatomegaly ($n = 7$), and hepatosplenomegaly ($n = 4$). Among those who presented with splenomegaly, none was in the first 2 months of life, and 1, 3, 2, and 1 were in the third, fourth, fifth, and sixth months of life respectively. The mean (\pm SD) of their ages was 4.0 (0.4), with a range of 2.4 to 5.7 months. The mean (\pm SD) size of the enlarged spleens was 4.4 (0.4) cm, with a range of 3.0 to 6.0 cm. Among those who presented with liver enlargement, only 1 was aged < 2 months. Their mean (\pm SD) age was 4.1 (1.6), and the mean (\pm SD) size of the enlarged liver was 3.3 (0.4) cm with a range of 2–4 cm. Enlargement of both the liver and the spleen occurred in 4 infants with parasites, whose mean (\pm SD) age was 4.4 (0.5) months, with a range of 3.6 to 5.7 months, and among whom none was aged < 2 months.

Age-specific hematocrit of infants with parasites. The mean hematocrit of infants with and without malaria parasites relative to their ages is shown in Table 5. There was a significant ($P = 0.03$) difference in mean hematocrit of infants aged 2 to 2.9 months with (30.1%) and without (33.1%) malaria parasites. In all, the mean hematocrit of infants with parasites ($n = 121$; hematocrit, 33.0%) was significantly lower ($P = 0.003$) than that of infants without parasites ($n = 325$; hematocrit, 35.1%).

Parasite density. The overall geometric mean parasite density of infected children was 202.5 (range, 12–65,317; Table 6). Spread over the different age groups, there was no consistency in the geometric mean parasite density of the subjects, being 100.9 in the youngest age group, 280.2 in the 4-month-old group, and 170.1 in the 6-month-old group. Parasite density (per microliter of blood) was thereafter divided into 6 categories: 1–500, 501–1,000, 1,001–2,000, 2,001–5,000, 5,001–10,000, and $> 10,000$ and tabulated against mean body temperature, mean hematocrit, and proportion of infants with and without anemia. A gradual increase in body temperature and a simultaneous decrease in hematocrit level were observed as parasite density increased.

TABLE 6
Mean temperature, mean hematocrit, and anemia status relative to parasite density of the infants in the study

Variable	Parasite density, parasites/ μ L					
	1–500	501–1,000	1,001–2,000	2,001–5,000	5,001–10,000	$\geq 10,001$
Number	97	9	6	4	1	4
Temperature ($^{\circ}$ C)						
Mean	36.7	36.9	37.0	37.9	36.5	38.3
\pm Standard deviation	0.5	0.5	0.6	0.4	0.0	0.4
Minimum	35.7	36.0	36.4	37.5	36.5	37.8
Maximum	38.0	37.4	38.0	38.4	36.5	38.7
Hematocrit (%)						
Mean	33.7	32.3	28.7	27.3	28.0	30.9
\pm Standard deviation	6.8	5.8	9.5	6.1	0.0	8.6
Minimum	19.0	22.0	12.0	20.0	28.0	20.0
Maximum	60.0	43.0	39.0	34.0	28.0	41.0
Without anemia (hematocrit $\geq 33\%$)						
Number	57	4	2	1	0	1
Percentage	58.8	44.4	33.3	25.0	0.0	25.0
With anemia (hematocrit $< 33\%$)						
Number	40	5	4	3	1	3
Percentage	41.2	55.6	66.7	75.0	0.0	75.0

DISCUSSION

Malaria is endemic in metropolitan Lagos. Its large population lives in cramped and crowded houses, which provide an ideal environment for the spread of malaria. We have studied malaria infection and disease in infants aged ≤ 6 months at Massey Street Children’s Hospital in metropolitan Lagos. Our study revealed that about 27% of infants in the first 6 months of life who presented ill to the hospital had malaria infection. Low malaria parasite density of 1–500 parasites/ μ L in malaria-naive infants can rapidly progress to a life-threatening situation. Malaria antibodies play a role in passive immunity to malaria at an early age. In a study of passively transferred maternal malaria antibodies of *P. falciparum* and the dynamics of active acquisition of these antibodies during the first year of life, it was observed that IgG levels fell from birth until the age of 4 months. This was followed by a steady rise thereafter until 10 months of age.¹⁵ Immunoglobulins are also derived from colostrum. Reduced antimalarial immunoglobulin levels in mothers could increase the likelihood of congenital malaria parasitemia in their offspring.

In our study, 12 (18.5%) of 65 one-month-old infants were infected with malaria parasites. Some of these cases could be congenital. The earliest time after birth that a child was found with malaria parasitemia is the first day of life. Congenital malaria usually clears by the 28th day of life. The switch from fetal to adult hemoglobin contributes to clearance of congenitally acquired malaria parasites at the end of the first month of life. We did not wait until 28 days had passed to repeat the blood smear for malaria parasites to determine whether the parasites would be spontaneously cleared or not. The infants were treated with an adequate dosage of chloroquine syrup over the course of 3 days. The mother’s occupation possibly influences malaria infection in the child. Mothers who are traders (especially those with little formal education) usually do not devote adequate time

to caring for their children but instead devote most of their time to trading.

Analgesics and hematinics are usually given to febrile infants. These have no effect on the evolution of malaria infection. Fever is the first sign noticed by the mother, and over-the-counter analgesics are usually within easy reach. These are administered as the first-line drugs in the home treatment of malaria. When the child's fever reduces as a result, the mothers, likely unaware that parasites are multiplying in the child, turn their attention back to trading. Antimalarial drugs, even when they are given, are usually administered in inadequate dosages.

In an earlier study in Nigeria, the risk of acquiring an episode of clinical malaria increased from birth to 6 months of age, after which it decreased.¹⁶ The overall prevalence of *P. falciparum* parasitemia in the mentioned study was highest in the 6-month-old infants (50%). In contrast, our findings showed the highest prevalence of falciparum parasitemia (38%) and the heaviest parasitemia load occurred among 4-month-old infants.

There was no trend in the age-specific parasite rate among the infants studied. From this, it can be reasoned that malaria infection in infancy is not age-related but fortuitous. Thus, the likelihood of malaria infection is dependent on the transmission level at any given time. It is not surprising, therefore, that the highest parasite density and parasite rate occurred during the month of September. It is at this time of the year that conditions—relative humidity, frequent rainfall, and high temperature—are most suitable for malaria transmission in the area.

Clinical diagnosis of malaria, especially in infants, has a poor diagnostic accuracy and a low positive predictive value because symptoms and signs are variable and can easily be mimicked by other infections and noninfectious diseases.¹⁷ Our study showed a low positive predictive value of ~30%, indicating a high degree of misdiagnosis of malaria in infants. Clinicians in Nigeria, where malaria is holoendemic, usually treat any fever as malaria until proven otherwise. Infants aged < 1 month old were the least likely to be diagnosed as having malaria or to have malaria parasitemia. The most likely reasons for this are presence of ample maternally derived malaria antibodies and the protection provided by fetal hemoglobin. Infants aged ≥ 2 months showed obvious signs and symptoms attributable to malaria. Premature waning of maternal antibodies, early removal of fetal hemoglobin, and effects of early viral and bacterial infections are some possible factors that might render the immunity of these infants unable to protect them against malaria.

That fever is the most common sign of clinical malaria is axiomatic, but in infants, apyrexial malaria parasitemia is quite common, as shown in this study. These infants therefore demonstrate characteristics associated with semi-immune adults. That is, only a small percentage of infected < 6-month-old infants come down with malaria. Low parasite density, evident in the majority of the infants we studied, is also commonly seen in the asymptomatic semi-immune adult. Data from our study showed that 13% of malaria-attributable morbidity corresponded to axillary temperature of < 37.5°C, contrary to the value 66.5% obtained from a study in Tanzania.¹⁸ Factors that may contribute to rise in

body temperature consequent upon increase in parasite density could be adjustment of the temperature-regulating center of the body, pyrogenic substances released by the infecting plasmodium parasites, and the parasite load.

A brief laboratory examination for anemia and malaria parasitemia in an infant presenting with vague symptoms is helpful to confirm malaria and its attending anemia. Taking the time to conduct this simple investigation could drastically reduce the infant mortality that is already high in these areas.

The fact that only 17% of infants in their sixth month of life were found to have parasitemia could be because of the common practice of home treatment in this age group. In younger infants, mothers would probably consult the hospital first, before any home treatment is provided, whereas in older infants, home treatment is usually given first before consultation.

No infant aged < 2 months had a palpable spleen. The spleen was probably not enlarged by the initial infection but was gradually enlarged as a result of persistent or repeated infection. Our results agree with those of an earlier study⁷ that showed that spleen was not palpable until the third month of life.

Finally, malaria should be considered as a serious childhood illness that contributes to the high infant mortality seen in the African population. Data from this study suggest that suspicion of malaria should be high when infants present with a variety of symptoms other than fever. Furthermore, this study suggests that a high index of suspicion of malaria should be aroused in the clinician when a child aged ≤ 6 months presents with nebulous signs and symptoms; these should be investigated and treated promptly.

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