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Prevalence of Malaria and Anemia Among Young Children in a Tertiary Hospital in Benin City, Edo State, Nigeria

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We aimed to determine the prevalence of malaria and anemia among children ≤5 years old in Benin City, Edo State, Nigeria. We also assessed the effects of age and sex on disease prevalence. Blood samples were collected from 1325 children (744 males and 581 females) with signs and symptoms of malaria. Malaria parasitemia was diagnosed by microscopy, while anemia was defined as hemoglobin concentration <11g/dL. Males had a significantly higher risk of malaria infection (odds ratio, OR, 1.399; 95% confidence interval, CI, 1.087–1.801, $p<0.009$), while females had a significantly higher risk of anemia (OR, 2.711; 95% CI, 1.872–3.929; $p<0.001$). Generally, age did not affect the prevalence of malaria—except among males, where children between 2–3 years old had a significantly ($p=0.006$) higher prevalence. Generally and among males, age affected the prevalence of anemia with children 4–5 years old having significantly ($p<0.001$) lower prevalence of anemia. Malaria was a risk factor for acquiring anemia (OR, 2.289; 95% CI, 1.630–3.214; $p<0.001$). Overall prevalences of 75.77% and 87.32% for malaria and anemia, respectively, were observed. While malaria parasitemia was higher among males, anemia was higher in females. Malaria and anemia were affected by age only in males. Effective control measures against malaria are advocated.

Key Words: anemia; Benin City, malaria; Nigeria

Introduction

Each year, 500 million infections and up to 2.7 million death are attributable to malaria,[1] with about 90% of these deaths occurring in children in sub-Saharan Africa.[2] It is estimated that an average of one person (usually a child under 5 years of age) dies every 12 seconds from malaria.[3] Despite a better understanding of the pathophysiology and management of malaria, childhood mortality remains unacceptably high.[4]

Anemia is one of the complications seen in malaria infection and contributes to its morbidity and mortality. It has been reported that over half of malaria-related deaths are attributable to severe anemia.[5] Preventing fatal outcomes in malaria cases requires recognition of infection, accurate laboratory diagnosis, and prompt therapy.[6,7] This is further stressed by its importance in the millennium development goals.

In relation to age, the prevalence of malaria differs between studies. Some studies report an

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inverse relationship between age and malaria prevalence,[8,9] while others find an increase in malaria prevalence with age.[10] Against this background, this study aimed to determine the prevalence of malaria and anemia among children younger than 5 years old, and to examine the effect of age and sex on prevalence.

Materials and Methods

Study population

A total of 1325 children aged ≤5 years were recruited for this study; all had signs and symptoms of malaria. The children consisted of 744 males and 581 females attending the children emergency clinic in the University of Benin Teaching Hospital (a tertiary hospital with a referral status), Benin City, Nigeria. Verbal informed consent was obtained from each parent or guardian of the children used. The protocol for the study was approved by the ethical review committee of the University of Benin Teaching Hospital.

Collection and processing of specimens

About 5 mL of blood was obtained from each patient, dispensed into a container with EDTA acid and mixed. Malaria was diagnosed by examination of a thick blood film using methods previously described.[7] Briefly, thick blood film was made from each specimen and stained with Giemsa stain. The smears were examined using 100× oil immersion. A total of 200 fields per smear were examined. The presence of any stage of malaria parasite was taken as positive while its absence was taken as negative.

Hemoglobin estimation was determined using an autoanalyzer, Sysmex KX-21 (Sysmex Corporation, Kobe, Japan). Anemia was defined according to the WHO criteria, i.e. hemoglobin concentrations less than 11 g/dL.

Statistical analysis

The data obtained were analyzed using χ^2 test and odds ratio analysis.

Results

A total of 1004 of 1325 children (75.77%) used in this study had malaria. The prevalence of malaria was significantly higher in males than females (78.49% *vs*. 72.29%; $p=0.009$) (Table 1). Generally, the prevalence of malaria was not significantly affected by age ($p=0.577$). However, considering sex, the prevalence was significantly higher among males between 2–3 years of age ($p=0.006$; Table 1).

Female sex was a significant risk factor for anemia among children (female *vs*. male: 92.94% *vs*. 82.93%; odds ratio, OR, 2.711; 95% confidence interval, CI, 1.872–3.929; $p<0.001$) (Table 2). Generally, and among males, children between 4–5 years of age had significantly lower prevalence of anemia ($p<0.001$) (Table 2). Finally, malaria was a significant risk factor for development of anemia. (OR, 2.289; 95% CI, 1.630–3.214; $p<0.001$).

Table 1 Prevalence of malaria among study subjects

Characteristic	Number tested	Number positive (%)	OR	95% CI	*p*
Sex					
Male	744	584 (78.49)			
Female	581	420 (72.29)	1.399	1.087–1.801	0.009
Age (yr)					
0–1	382	284 (74.35)			
2–3	590	455 (77.12)			
4–5	353	276 (78.19)			0.58
Age by sex (yr)					
Male					
0–1	232	178 (76.72)	2.973	2.030–4.355*	
2–3	301	253 (84.05)	4.754	3.235–6.987*	
4–5	211	153 (72.51)			0.006
Female					
0–1	150	106 (70.67)	1.506	0.949–2.388*	
2–3	289	202 (69.90)	1.451	0.982–2.144*	
4–5	142	112 (78.87)			0.12

*Comparison with the 4–5-year-old age group. OR: odds ratio; CI: confidence interval.

Table 2 Prevalence of anemia in relation to age and sex

Characteristic	Number tested	Number positive (%)	OR	95% CI	*p*
Sex					
Male	744	617 (82.93)			
Female	581	540 (92.94)	2.711	1.872–3.929	<0.001
Age (yr)					
0–1	382	340 (89.01)			
2–3	590	541 (91.69)			
4–5	353	276 (78.19)			<0.001
Age by sex					
Male					
0–1	232	201 (86.64)	3.430	2.138–5.504*	
2–3	301	278 (92.36)	6.394	3.834–10.661*	
4–5	211	138 (65.40)			<0.001
Female					
0–1	150	139 (92.67)	0.366	0.114–1.179*	
2–3	289	263 (91.00)	0.293	0.100–0.857*	
4–5	142	138 (97.18)			0.062

*Comparison with the 4–5-year-old age group. OR: odds ratio; CI: confidence interval.

Discussion

Malaria remains a burden in sub-Saharan Africa, especially among children,[8] and anemia has been reported to be responsible for over half of malaria-related deaths.[5] Accurate information on prevalence is invaluable for planning control activities and monitoring their efficacy over time.[10] This study focused on the effect of age and sex on the prevalence of malaria among young children.

An overall prevalence of 75.77% of malaria infection was observed in this study. This is a very high prevalence, presumably attributed to poor control measures. In countries like Togo, long-lasting insecticide-treated nets were distributed throughout the country.[9] This kind of control program has not been conducted in Nigeria. The Ministry of Health and other agencies concerned with malaria eradication should put appropriate measures to stem the tide.

The data also show that clinical diagnosis is limited, as approximately 24% of the stained films were negative. This observation had earlier been noted[8] and may be due to self-medication which is common in this locality.

Male sex was a risk factor for malaria parasitemia, a finding in agreement with earlier reports.[10] However, Incardona et al[11] analyzed children and adults with ages ranging from <5 years to >41 years. The reason for the high prevalence of malaria among males in this study is not clear. The prevalence of malaria infection did not differ significantly between the age groups of the study population, except in males in whom those between 2–3 years of age had the highest prevalence.

It has been previously reported that neonates and children <1 year old have a low prevalence of malaria owing to the fact that liver cells appear innately resistant to sporozoites.[12] This is coupled with the inability of *Plasmodium falciparum* to grow rapidly in red cells containing fetal hemoglobin.[13] This may explain the general observation of increase in malaria prevalence between 0–1 and 2–3 years. With the exception of females in whom the prevalence continued to increase, malaria prevalence decreased between the ages of 2–3 and 4–5 years in this study. The age-related burden of malaria is consistent with previous studies characterizing malaria morbidity patterns in West Africa.[14,15] Modiano et al[15] researching in Burkina Faso in an area of documented intense transmission, found that 78.2% of cases of severe malaria in rural areas occurred in children <2 years of age. Similarly, Binka et al[14] found parasite densities and rates of febrile illness highest in children between 6 and 11 months of age, an observation that is consistent with immunity acquired in an exposure-related manner.[8,16] Elsewhere, severe malaria tends to occur in older children.[17] Differences in the age of presentation of severe malaria may be the result of lower background immunity or other undefined variables.[18]

Females had significantly higher prevalence of anemia than their male counterparts (92.94% *vs.* 82.93%; $p<0.001$). The reason for this difference is not clear. Generally and among males, the prevalence of anemia increased between the ages of 0–1 years and 2–3 years, while it dropped between 2–3 years and 4–5 years. This finding is attributed to a prevalence of malaria among the age groups

(Table 1). That is, as malaria parasitemia decreases, the prevalence of anemia reduces. Indeed, malaria parasitemia was a significant risk factor for acquiring anemia in this study (OR, 2.289; 95% CI, 1.630–3.214; $p<0.001$). The data shows that some patients with malaria did not have anemia and vice versa.

Malaria, which is clinically indistinguishable from other infections such as septicemia, is not the only cause of anemia. This may be responsible for the cases of anemia without malaria. Anemia has been reported as an important cause of malaria-related deaths.[5] Furthermore, the main burden of anemia occurs in the first 2 years of life, with the peak portion of moderate-to-severe anemia in children between the ages of 6 and 17 months, indicative of a population that is exposed to high malaria transmission levels.[9] Therefore, there is need to treat patients for both malaria and anemia. There is also the need for an effective control program for malaria.

This study reveals a high prevalence of malaria parasitemia and anemia (75.77% and 87.32%, respectively). While males have a higher prevalence of malaria parasitemia, females have a higher prevalence of anemia.

Malaria parasitemia and anemia reduce by the age of 5 years. Effective control programs to combat malaria and associated sequelae are advocated.

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