

Prevalence and Severity of Malaria Parasitemia among Children Requiring Emergency Blood Transfusion in a Tertiary Hospital in Imo State, Nigeria

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Abstract

Background: Malaria is one of the most serious and complex health problems in Sub Saharan Africa. Anemia in Children with malaria may require blood transfusion and has been be associated with high mortality rates. **Aim:** The aim of this study is to evaluate the prevalence, pattern, and severity of malaria parasitemia among children 6 months to 14 years old, requiring blood transfusion. **Subjects and Methods:** This is a cross-sectional study carried out at the children emergency unit of the Imo state University Teaching Hospital South East Nigeria. Data were analyzed using SPSS version 21, Chicago II, USA **Results:** A total of 409 children were recruited into the study. The overall rate of malaria parasitemia was 83.1% (340/409) lower in males 81.6% (228/276) than in females 86.3% (112/133). The peak of parasitemia is similar in both sexes (5-9 years). Most of the children had medium levels of parasitemia, which decreased with increasing age. The proportion of children transfused also decreased with increasing age. At medium and high levels of parasitemia; in children below 5 years, 92.8% (132/142) were transfused while in 5 years and above only 79.6% (39/49) of the children were transfused. At medium level parasitemia the proportion of children transfused was significantly higher than those not transfused ($P < 0.001$). **Conclusion:** Most children 6 months to 14 years with medium level of parasitemia may require blood transfusion. Targeted measures toward primary prevention of malaria in children should be intensified as this will not only reduce morbidity and mortality of malaria, but will reduce the economic burden of the disease in Semi-rural and rural dwellers in Sub Saharan Africa.

Keywords: Africa, Blood transfusion, Children, Malaria, Nigeria

Introduction

Malaria is one of the most serious and complex health problems in Sub Saharan Africa. Over 80% of the world wide cases of malaria occur in Africa and especially in children.^[1] Malaria

induced anemia is much more common in younger children and may require blood transfusion with high mortality rates.^[2,3] In Sub-Saharan Africa (SSA), children admitted with severe anemia are more likely to die than those without anemia.^[4,5] Blood transfusion in severe malarial anemia can be important in preventing death in very ill patients^[6] as well as clinical deterioration. Transfusion also shortens recovery from anemia, hospital stay, reduces the length of time during, which patients are vulnerable as a result of their anemic state.^[7] In hospitalized children, the prevalence of severe anemia ranges from 8% to 29%^[8,9] and for 70% of all transfusions prescribed.^[10]

To the best of our knowledge, no study has documented the prevalence of anemia and pattern of malaria parasitemia in

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children in Imo state South East Nigeria (SEN). The aim of this study is to evaluate the prevalence, pattern, and severity of malaria parasitemia among children 6 months to 14 years old, requiring blood transfusion, which may be used as targets for primary prevention.

Subjects and Methods

This is a cross-sectional study carried out at the children emergency unit of the Imo state University Teaching Hospital (IMSUTH). The hospital receives patients from all over Imo state and the surrounding states of SEN. It is situated in Umuna, a semi-urban area, in Orlu Local Government Area of Imo State Nigeria. Umuna is located between longitude 6°54' east and 7°7' east, and latitude 5°44' north, and 5°54' north, with a population of about 305,000 and average density of 905 persons/km. It is in a tropical rainforest zone with a mean temperature range between 37.9°C (February to April), to 26°C (July to September). Rain is seasonal, most of it, falling between April and September. The monthly average rainfall is between 32.5 mm and 38.5 mm. Topographically, Umuna is a flat surface area, with few sloppy, but not set landscapes. The town has one stream, which is also seasonal.

Consecutive consenting patients age 6 months to 14 years admitted at the children emergency department of the hospital were recruited. Only children with clinical and diagnosis of malaria with anemia were included in the study. Where there are other possible causes of anemia, such cases were excluded. All cases of previous blood transfusion in the past 6 months were also excluded. Consent was obtained from the parent (s) of the child or their care giver after explaining the methods, aims, and objectives of the study. Older children who could talk also gave their consent in addition to that of their guardians. The study was carried out from December 3, 2007, to May 8, 2008 at the Children Emergency Ward of IMSUTH, Umuna, Orlu. Ethical clearance was obtained from the Ethics Committee of the IMSUTH, Umunna.

Definition of terms

Anemia^[11,12] was defined based on Table 1.

Age group	Anemia (hemoglobin level (g/l))		
	Mild	Moderate	Severe
6 months to 4.9 years	100-109	70-99	<70
5-9 years	110-114	80-109	<80
10-14 years	110-119	80-109	<80

Table 1: Age and sex distribution

Age group (years)	Males (%)	Females (%)	Total
0-4	147 (52.9)	65 (49.6)	212 (51.8)
5-9	99 (35.6)	46 (35.1)	145 (35.5)
10-14	32 (11.5)	20 (15.3)	52 (12.7)
Total	278 (68)	131 (32)	409 (100)

Sample collection

About (3-4) ml (m/s) of venous blood was collected from each child into ethylene-diamine-tetra-acetic-acid.^[13] Malaria parasitaemia (Mp) was assessed by microscopic examination of Geimsa-stained thick-film method. For a (20-30) min staining procedure, about 3% solution of Giemsa-stain was prepared, by adding 1.5 ml of Giemsa stain by means of a dry-graduated-plastic-bulb pipette, to 50 ml of buffered water (of pH: 7.2). Positive blood film for malaria parasite were expressed in order as: Scanty: (±), Low: (+), Moderate: (++) and High: (+++), these expressions were based, on the average number of parasites seen, per microscopic-field, and each expression correlating with the nature and severity of Mp. Laboratory analysis was done 2-3 h after sample collection. Medical history and/or clinical diagnosis made by the medical doctor on call at the time of admission were noted. The study was carried out from December 3, 2007, to May 8, 2008 at the Children Emergency Ward of the Hospital. Ethical clearance was obtained from the Ethics Committee of the hospital.

Data were analyzed using SPSS version 21, Chicago IL, USA). Proportions were compared using the Mann-Whitney U-test and Kruskal-Wallis test. In all, $P < 0.05$ was regarded significant. Conclusions were drawn at the level of significance. The confidence level was kept at 95%.

Results

A total of 409 children - 67% (276/409) males and 38% (133/409) females were recruited into the study. The mean age was 5.2 (Standard deviation [SD]: 3.7, 95% confidence interval [CI]: 5-5.7) years (range 6 months to 14 years). There was no statistical difference between the ages of males 5.4 (SD: 3.7, 95% CI, 4.9-5.9) years and females 5.3 (SD: 3.6, 95% CI: 4.8-5.9) years $P = 0.92$. The age and sex distribution of the patients is shown in Table 1. Most of the children were <5 years. The male female ratio of 2.1:1.

The overall rate of malaria parasitemia was 83.1% (340/409) lower in males 82.2% (227/278) than in females 84.2% (112/131), $P = 0.69$. Age and sex specific rate of parasitemia is shown in Table 2. The peak of parasitemia is similar in both sexes (5-9 years). *Plasmodium falciparum* was the only malaria parasite species that was detected in all the infected children.

Most of the children had moderate parasitemia 45.7% (187/409) and four children (0-4 years) had high-level parasitemia. In general, frequency of medium level of parasitemia decreased with increasing age. Low-parasitemia was more common among older children. Scanty parasitemia was however higher between the ages of 5 and 9 [Table 3]. The total number of children who had negative 16.9% (69/409), scanty 15.2% (62/409) and low 21.3% (87/409) was 53.7% (218/409) of the population studied.

Table 2: Frequency of parasitemia in different age groups

	Males		Females		Total		P value
	Mp+*	Mp-**	Mp+	Mp-	Mp+	Mp-	
0-4	122 (83)	25 (17)	57 (87.7)	8 (12.3)	179 (84.4)	33 (15.6)	0.26
5-9	82 (84.6)	15 (15.5)	42 (89.6)	6 (10.4)	124 (85.5)	21 (14.5)	0.47
10-14	24 (75)	8 (25)	13 (65)	7 (35)	37 (71.2)	15 (28.8)	0.98
	228 (82.6)	48 (17.4)	112 (84.2)	21 (15.8)	340 (83.1)	69 (16.9)	

*Mp+: Malaria parasite positive, **Mp-: Malaria parasite negative

Table 3: Intensity of Mp in different age groups

Age group (years)	Scanty ±	Low +	Medium ++	High +++	Mp negative	P value
4	22 (10.4)	15 (7.1)	138 (65.1)	4 (1.9)	33 (15.7)	<0.001
5-9	34 (23.4)	47 (32)	43 (29.7)	-	21 (14.5)	
10-14	6 (11.5)	25 (48.1)	6 (11.5)	-	15 (28.8)	
Total	62 (15.2)	87 (21.3)	187 (45.7)	4 (1)	69 (16.9)	

Mp: Malaria parasitemia

Of the 340 malaria positive children, 55.6% (189/340) were transfused; 74.6% (141/340) of them were 4 years and below. The proportion of children transfused dropped dramatically with increasing age. Furthermore, the proportion of children transfused in each age varied significantly with the level of parasitemia [Table 4].

At scanty and low parasitemia, a total of 9.7% (6/62) and 11.5% (10/87) were transfused respectively. This proportion was evenly distributed between children <5 years and 5-9 years. Only 6.5% (2/31) of children 10 years and above required transfusion in this group. At medium and high levels of parasitemia most children were transfused-91.4% (171/187) and 50% (2/4), respectively. In those below 5 years, 95.7% (132/138) and 50% (2/4) were transfused, respectively, while 5 years and above, about 79.6% (39/49)% of the children were transfused. Below the age of 5, the proportion of children with scanty and low levels of parasitemia were <30% of those transfused in each group [Table 4].

The proportion of children transfused was significantly higher at moderate level parasitemia ($P < 0.001$).

Discussion

This study has demonstrated a high level of malaria parasitemia (83.1%) among children requiring blood transfusion in a tertiary hospital in Imo state SEN. Although, most of the study period fell within the dry season (December-May with <4 weeks into the rainy season) thus confirming the hyperendemic nature of the disease.^[2,3] The rate of parasitemia was however higher than in previous reports.^[2,3] Several factors may contribute to the persistent high rate of Mp in semirural communities in SEN: Fast growing urban centers, poor environmental and sanitary conditions, ecological factors, inadequate ante-natal care, poor perception and attitude of the susceptible populace to malaria intervention programs, are all

contributory. Umunna is in the heart of the tropical rainforest with high malaria endemicity unlike the earlier studies from East African Savanna areas.^[3]

This study also revealed a moderate to high level of parasitemia requiring transfusion in children <5 years which also supports earlier reports.^[3,14-17] Most children with medium levels of parasitemia (91.4%) eventually received blood transfusion compared to 9.7% with scanty parasitemia and 11.5% with low level parasitemia. At different age groups, those with medium levels of parasitemia had higher proportion of blood transfusion, which decreased as the age of the children increased. Furthermore, even with scanty and low levels of parasitemia 4.8% of children <5 years and 5-9 years received blood transfusion in each group. This finding supports the high risk of attributable risk of severe anemia associated with *P. falciparum*.^[4,18,19]

With scanty and low level of parasitemia, in children 5-14 years about 8% were not transfused compared to 23.3% in those <5 years. These findings may suggest that even at scanty and low levels of parasitemia, malaria may still cause severe anemia in younger children. However, poorly developed immune system, small blood volume as well as other comorbid factors such as malnutrition, which is prevalent in children <5 years in Sub Saharan Africa.^[14] On the other hand, low rate of transfusion among the older children may be attributable to, better antimalarial immunity and better nutritional status (these children could make choices in terms of the types of food they would eat compared with younger ones) as well as the attitude of parents toward ante-natal/postnatal care may also be contributory.^[19]

One important implication of this study is in primary prophylaxis and reduction of cost of treatment of malaria. Children <5 years are more likely to be at home with their parents, thus proper dressing and use of insecticide treated nets can easily be applied. In SSA, the cost of blood transfusion and extra days on admission are added economic burden to most families; hence the importance of proper malaria prophylaxis in children especially those <5 years.

Another interesting finding from this study is the number of children who were parasite negative which may indicate possible misdiagnosis (one may assume that cases of possible misdiagnosis will include those with negative parasitemia and possibly those with scanty parasitemia). When those with

Table 4: Intensity of malaria parasitemia among children who were transfused

Level of parasitemia	0-4		5-9		10-14		Total		P value [#]
	nt	t	nt	t	nt	t	nt	t	
Scanty	19 (30.6)	3 (4.8)	31 (50)	3 (4.8)	6 (9.7)	-	56 (90.3)	6 (9.7)	0.41
Low	11 (12.6)	4 (4.6)	43 (49.4)	4 (4.6)	23 (26.4)	2 (2.3)	77 (88.5)	10 (11.5)	0.12
Medium	6 (3.2)	132 (70.6)	8 (4.2)	35 (18.7)	2 (1.1)	4 (2.1)	16 (8.6)	171 (91.4)	<0.001
High	2 (50)	2 (50)	-	-	-	-	2 (50)	2 (50)	1.00
Total	39 (25.8)	141 (74.6)	82 (54.3)	42 (22.2)	31 (20)	6 (3.2)	151 (44.4)	189 (55.6)	

nt: Not transfused, t: Transfused. [#]Mann-Whitney U-test

scanty parasitemia are added to those who were negative; then the proportion with possible misdiagnosis will be 55 (25.9%), 55 (37.9%) and 21 (40.4%) in the 6 months to 4 years, 5-9 years and 11-14 years, respectively. This calls for proper training and retraining of emergency department doctors, laboratory scientists as well as improvement and upgrading of laboratory tools for quick and accurate diagnosis of malaria. Other possible reason for negative/scanty parasitemia would include use of antimalarials at home, which is common in our environment. Misuse of medication especially antimalarials is well-documented.^[20] Parents are likely to self-medicate or visit primary health care centers before seeking care from tertiary centers. Furthermore, the role other infective and parasitic agents as well as malnutrition in the cause of anemia in children in the tropics has been well-established.^[14,21]

Limitations

This study has some limitations. Anemia in the tropics may be due to several causes and not necessarily malaria. Clinical diagnosis of malaria was the basis for patient selection thus even among those with positive parasitemia other causes of fever may be the cause of admission. Previous drug treatment and nutritional history might have affected laboratory diagnosis and the degree of anemia.

Conclusion

Most children 6 months to 14 years with medium level of parasitemia may require blood transfusion. Targeted measures toward primary prevention of malaria in children <5 years should be intensified as this will not only reduce morbidity and mortality of malaria, but will reduce the economic burden of the disease in Semi-rural and rural dwellers in Sub Saharan Africa.

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