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Plasmodium Infection in Severely ill Children Aged 0-8 Years in Maiduguri Metropolis, North Eastern Nigeria

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The prevalence of malaria in 411 severely infants and children aged under 8 years old (6-9 months) was studied by consecutively screening each child for malaria parasites in accordance with WHO (1996) and WHO (2003) methods for a period of 8 months. One hundred and twelve infants and children (27.2%) were positive for asexual malaria parasites. 15.8% were males while 47 (11.4%) were females. Infection rate was not significantly different between the sexes ($p>0.05$). The level of parasitaemia were significantly related to age ($p<0.05$) the majority 87 (77.6%) of infected infants and children were between the ages of 12-36 months. 77 (66.1%) had <1000 ap/µl, 7 (6.2%) had 1000-5000 ap/µl while 6 (5.3%) had >5000 ap/µl. During the rainy season 87 (77.6%) had <1000 ap/µl, 7 (14.2%) had 1000-5000 ap/µl while 4 (8.1%) had >5000 ap/µl. During the dry cold season 57 (90.4%) infants and children had < 1000 ap/µl, 1 (1.5%) had 1000-5000, while 5(7.9%) had > 5000 ap/µl. There was a significant difference between the seasons ($p<0.05$). The low parasite density of <1000 ap/µl in 84% of all the cases confirms the distinctive epidemiology of urban malaria and highlights the need for the use of rapid diagnostic tests in addition to thick blood film microscopy to help reduce the margin of errors in the diagnosis of malaria in the sahel.

Key words: Children, malaria, Northeast Nigeria, rapid diagnostics tests

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INTRODUCTION

Malaria is a major health problem in Nigeria, a major cause of morbidity and mortality of children and adults in Borno State among other states in zone D of the primary health care programme comprising Adamawa, Bauchi, Borno Gombe Jigawa, Kano, Taraba and Yobe States[1].

Quite unlike in the adults and the adolescents where the symptoms of malaria (such as headache, fever malaise, myalgia, diarrhoea and vomiting) are fairly obvious, in children, the symptoms are more diverse and resemble those of other disease conditions like pneumonia, meningitis, acute gastro intestinal disorders, encephalitis, heat exhaustion and even hepatic dysfunction[2,3].

It was observed that out of five hundred and twenty two children of ages nine years and below attending maternal and child welfare clinics in Jos area of Plateau State, Nigeria who were clinically diagnosed by medical doctors as having malaria when subjected to parasitological examination by microscopy for malaria parasites only 41% had malaria parasites in their blood[4]. In North Eastern Nigeria at least 71.2% cases presenting with fever especially in the dry season are being erroneously diagnosed as malaria[5].

The transmission of malaria is however less intense and unstable in Northern Nigeria[6].

This study aims to look at malaria parasite density in severely ill children hospitalized at the Emergency paediatric unit of University of Maiduguri Teaching Hospital, in the course of eight months in relation to the distinctive epidemiology of Urban Malaria[7]. Information on Sahel malaria at the local level is scanty. This is to be an addition to an already existing baseline data.

MATERIALS AND METHODS

This study was conducted at the Emergency Paediatric Unit (EPU) of University of Maiduguri Teaching Hospital (UMTH) over a period of eight months.

The UMTH serves as a referral central catering for the needs of the entire north east. Maiduguri is located on latitude 11°51' and longitude 13°09E mean annual rainfall of 650 mm, altitude 305 m. It is inhabited by about 877, 925 people (projected from 1991 census figure of 629,486 people). The area lies in the Sudano-Sahelian zone and experiences marked seasonal variation in the transmission of malaria[6]. It has short rainy season lasting from June/July to September/October and a long dry season, from October/November to May/June. The dry season has 2 parts to it; cold harmatttan period, from Nov/Dec. Jan and the hot period, Feb/March-April/May. *Plasmodium* species of malaria here are *P. falciparum* (90-95% and *P. malariae* (5-10%), *P. ovale* occurs very rarely and hardly exceeding 2% (Molta Pers. Comm., 2004).

Patient selection and screening: In all, 411 infants and children under 8 year Old (6-96 months) presenting at the EPU were consecutively and routinely screened for plasmodium infection. The World Health Organisation (WHO, 1996-2003) procedure was adopted for the detection of Plasmodium positive cases and identification of malaria parasites. Giemsa stained thick blood films were used for parasitological assessments and parasite densities were estimated using an average white blood cell count of 8000 μL^{-1} (WHO 1996) The parasitaemia per µL was calculated by using the formula:

Parasitaemia (per µL) = number of parasites x 8000/number of leukocytes (WHO, 1996).

Statistical analysis: Chi- square (χ^2) test or Fishers exact test where appropriate was used to compare proportions.

RESULTS

A total of one hundred and twelve children and infants were positive for malaria parasite out of four hundred and eleven. Though malaria infection was higher in males (57.7%) than females (42.3%) it was not statistically significant (Table 1). The level of parasitaemia were significantly related to age ($p<0.05$) the majority 87 (77.6 %) of infected infants and children were between the ages of 12 -36 months they had <1000 ap/µl, 7 (6.2 %) had 1000-5000 ap/µl while 6 (5.3 %) had >5000 ap/µl (Table 2).

In the rainy season 77.5% of the children had <1000 ap/µl of whole blood 14.28% had 1000-5000 ap/µl and 8.16% had >5000 ap/µl while during the dry cold season 90.48% of the children has <1000 ap/µl, 1.58% had between 1000-5000 ap/µl while 7.9% had >5000 ap/µl (Table 3a and b).

Asexual parasitaemia was significantly different between the two seasons (Rainy and Dry season) $p<0.05$ as shown on Table 4.

DISCUSSION

Data obtained during this study further confirmed the seasonality of malaria in this zone with an early and a late peak transmission.

Table 1: Prevalence of *Plasmodium* infection by sex

Sex	No. negative	No. positive	Total	Infection (%)
Male	172	65	237	15.82%
Female	127	47	174	11.44%
Total	299	112	411	27.26%

$\chi^2 = 0.0080$, df = 1, (NS) Non significant

Table 2: Relationship between asexual malaria parasites density and age in severely–ill children ( )%

	Frequency of patients in density classes					Statistical analysis		
Age (months)	<1000	1000-5000>	>5000	Total positives	Total negative	χ^2-value	df	difference
6-11	10 (8.9)	3 (2.7)	0 (0)	13	111	5.25	2	Significant
12-36	74 (66.1)	7 (6.2)	6 (5.3	87	88			
37-96	12 (10.7)	0 (0)	0 (0)	12	100			
Total	96 (85.7%)	10 (8.9%)	6 (5.3%)	112	299			

Table 3A: Parasitological data on Asexual stages of malaria parasites in 411 severely ill children of ages 1-8 years by months/seasons June-September 2003/rainy Season October 2003-January 2004 dry Cold Dry Season of the EPU UMTH and Hot/warm Season * No. ( ) are (%)

					Geometric mean malaria parasite density asexual parasite/µl	Asexual parasite density range (parasite/µl)	Frequency of patients in density classes Asexual parasite/µl		
Season	Months	No. examined	No. positive for malaria parasites	No. negative for malaria parasite			<1000	1000-5000>	5000
Rainy	June	30	16 (53.3)	14 (46.7)	63	15-407	16		
	July	19	9 (47.4)	10 (52.6)	107	16-1,613	8	1	
	August	68	14 (20.6)	54 (79.4)	353	32-12,280	9	4	1
	September	36	10 (27.8)	26 (72.2)	13.655	16-111,111	5	2	3
Total	4 months	153	49 (32.1%)	104 (67.9%)			38 (77.55%)	7 (14.28%)	4 (8.16%)
Table 3B:									
Cold dry season									
	Oct	55	14 (25.5)	41 (74.5)	4,916	16-250,000	11	0	3
	Nov	62	10 (16.1)	52 (83.9)	1,6 95	48-102,564	9	1	1
	Dec.	89	32 (35.9)	57 (64.1)	655	16.1600	31	0	0
	Jan	52	7 (13.5)	45 (86.5)	2,720	16-176,.000	6	0	1
Total	4 months	258	63 (24.4%)	195 (75.6%)			57 (90.48%)	1 (1.58%)	5 (7.9%)

$\chi^2 = 2.8$ df = 1 $p<0.05$ (Significant)

Table 4: Relationship between asexual parasites and season

Plasmodium parasitaemia	Rainy season	Dry season	Total
Negative	104 (67.97%)	195 (175.58%)	299
Positive	49 (32.03%)	63 (24.42%)	112
Total	153 (100%)	258 (100%)	411

A gradual build up of parasite density was observed during the rainy season with a sharp peak in September and gradual fall in parasite density tailing off as the dry season advances. This further confirmed the observation of Molineux and Gramiccia[8] that monitoring of malaria in the population in this region showed that there were seasonal patterns of acquisition and loss of infection but very little variation between years and only a slight reduction during the drought years. In this study low a sexual parasite densities was observed. The fact that this study was conducted in an urban area is important considering the fact that Urban malaria has a distinctive epidemiology, incidence of fatal malaria may increase where transmission falls, ironically while transmission of malaria may fall in core areas of the city, the incidence of severe and fatal may increases in these same neighbourhoods[7]. Some individuals develop severe and even fatal Malaria with a very low peripheral parasitaemia[9] as observed in this studies, from the findings of this study, prevalence of malaria in Maiduguri can be classified as mesoendemic. This classification is based on the cumulative prevalence of 27.26% obtained for population under study following the WHO[10] classification of malaria endemicity. No significant difference in prevalence of between males and females was observed in the present study and in agreement with Baird *et al.*[11]. The distribution of malaria cases amongst various age groups agrees with the reports of Molta *et al.*[12], White and Ho[13] that young children aged 0-4 years support the highest asexual and sexual parasite densities. Thus, infants suffer a disproportionately high rate of infection while older children are at a lower risk, presumably for immunological reasons. The highest Geometric Mean asexual Parasite Densities (GMPD) of 13,655 was observed in the month of September, this is in agreement with the unpublished records of the Borno State Ministry of Health which states that: transmission of malaria occurs all year round with peaks during the middle to late rainy season[14]. It is note worthy that Watila *et al.*[5] observed that in at least 71.2% cases of fever episodes in Maiduguri during the dry season are erroneously diagnosed as malaria. According to a study by Imandeh *et al.*[4] only 41.0% of clinically diagnosed patients for malaria were actually positive after a parasitological examination.

In conclusion, taking into consideration that in our study most of the positive cases had low asexual parasite densities, which in some cases can be very hard to detect by thick film microscopy because the parasites in the peripheral blood may have been sequestered into deep veins thus making them unavailable for detection[15]. We recommend the use of rapid diagnostic test (RDTs such as parasight RF. (PSF); Immuno Chromatographic Test (ICT), Quantitative Buffy Coat (QBC)[15] in addition to routine microscopy. These tests can be performed in

approximately 15 min[16] using the test kits require minimal training. No electricity and no complicated equipment. In this way, patients will be saved unnecessary expenditure on malaria drugs, prolonged state of illness and loss of time. There is also on the other hand a need to continually enhance the training of laboratory technicians in parasitology[4]. (Molta Personal Communication, 2004). Since the study area (Borno, Maiduguri) lies in a Zone of unstable malaria transmission with a short transmission season such that immunity in the populace is unable to reach a high level. We also in addition recommend vector control to policy makers to curtail explosive breeding of mosquitoes which could cause an out break of malaria especially during the rainy season[6,17].

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