

Malarial Parasitaemic and Splenic Rates among Highland Children in Jos

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Summary

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As an extension of a study on the relevance of malaria in post-operative morbidity of surgical patients, it was decided to study the magnitude of malaria problem in a selected population among the highlanders of Jos environs, namely: Jengre, Foron, Amokatako and Toro communities. A total of 836 children, aged between two and 14 years, were screened in the dry season, while 882 were studied during the rainy season. There was malaria parasitaemia rate of 23.3 percent and spleen rate of 15.07 percent during the dry season, while the respective figures during the rainy season were 40.03 and 21.09 percent. During the dry season, the average enlarged spleen (AES) ranged from 0.07 in Toro to 0.4 in both Jengre and Amokatako, while in the rainy season the range was from 0.1 in Toro to 0.6 in Amokatako.

Introduction

It is estimated that about 100,000 subjects, mainly infants and children, die yearly from malaria infection.¹ Previous studies have demonstrated that heavy malaria infection is associated with various abnormalities of immune reactivity leading to immunosuppression, the generation of autoantibodies and even increased

susceptibility and morbidity to infectious diseases.²⁻⁵ Ajayi and Ihekwaba⁶ have reported a preoperative parasitaemia rate of 18.75 percent among 32 surgical patients in Ibadan which is a low-lying area in Nigeria. Jos with a population of about 510,000 inhabitants and a land area of 4.28 km² is located in the highlands of Nigeria, a region situated about 1,200 metres above sea level, a rugged and undulating terrain with continuous soil erosion due to heavy rainfalls, sometimes lasting four to six months in the year.

In the past four years, the department of surgery, Jos University Teaching Hospital (JUTH), has embarked on evaluation of the role of malaria infection in post-operative morbidity and mortality among surgical patients. The present epidemiological survey was therefore, aimed at studying the seasonal variations of malaria epidemics in the population. It was hoped

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that a knowledge of the incidence, distribution and intensity of malaria infection showing the magnitude of the problem among the most susceptible group in the population, will help in evaluating the results obtained from our ongoing hospital-based study.

Subjects and Methods

A cross-sectional study was designed for three different communities (Jengre, Amokatako and Foron) adjoining Jos, the capital city. As a control, a nearby low-lying area, called Toro in Bauchi State, was also included in the study. The investigating team consisted of the chief investigator (CHI), a microbiologist (EII), a haematologist (GA) and three other technical staff. A courtesy call was first paid to the traditional chief of the area and then to the local government headquarters to explain the purpose of the study. After these calls, a date was fixed for the physical examination in the school premises, of all the children, aged between two and 14 years.

In order to eliminate one source of bias, the physical examination was performed only by the chief investigator with the child in supine position. The abdomen of the child was first palpated for the spleen during normal respiration and then repeated during deep respiration. Splenic enlargement was determined according to the criteria by Hackett⁷ and recorded into one of six classes (Table I).

After the examination, blood samples by finger-pricks were obtained from the children by the other investigators, using sterile lancets. From these samples, both thick and thin blood smears were made.

The spleen rate of each community was calculated by finding the percentage of all the children examined who had enlarged spleen of

classes one to five. For a more precise comparison of the intensity of malaria infection between communities, the average enlarged spleen (AES) was calculated, as the sum total of the product of the spleen class and the number of children in each class divided by the total number of children examined in that community.

Table I

*Classes of Splenic Enlargement,
according to Hackett⁷*

<i>Class</i>	<i>Description</i>
5	Large spleen; extends beyond halfway between umbilicus and symphysis pubis
4	Spleen below level of umbilicus but not below halfway between umbilicus and pubic symphysis
3	Spleen palpable on normal inspiration and expiration. Does not reach beyond level of umbilicus
2	Spleen palpable on normal inspiration but not on expiration. Does not project below midway horizontal line between costal margin and umbilicus
1	Spleen palpable only on deep inspiration
0	Normal spleen. Not palpable

In order to reduce to a minimum, the number of cases of splenomegaly from other non-related medical conditions, all known sicklers and subjects with tell-tale signs of sickle-cell anaemia, were excluded from the study. To assess seasonal fluctuation in the incidence of malaria, the month of December was chosen for the dry season study and that of July for the rainy

season. For the purpose of the present study, endemic malaria infection implies that the disease is being transmitted within the area under survey during at least, one season of the year. Malaria is regarded as hypoendemic when it is present all of the time, but is hardly measurable at certain seasons of the year. Spleen rates of less than 10 percent, 10 - 25 percent, 25 - 50 percent and above 50 percent are used to depict low endemicity, moderate endemicity, high endemicity and hyperendemicity, or post epidemic hyperendemicity, respectively. This is equivalent to AES of 0.1 - 1, 1 - 2 and greater than 2, respectively.

Results

A total of 1,718 children, aged between two and 14 years were studied during the two seasons (dry and rainy). There were 836 subjects (334 males and 502 females) in the dry-season study and 882 children (419 males and 463 females) in the rainy-season. Increased parasitaemia was more or less, evenly spread out among all age groups. The parasitaemia rates for the four communities for the dry and rainy seasons are shown in Table II.

Table II

Parasitaemia Rates in the Communities during the Dry and Rainy Seasons

Community	Dry Season		Rainy Season	
	No. of Children	Parasitaemia Rate (%)	No. of Children	Parasitaemia Rate (%)
Jengre	203	18.7	203	48.6
Foron	166	12.4	271	35.6
Amo-Katako	247	44.2	191	53.7
Toro	220	15.6	217	28.3
Total	836	22.7	882	41.6

It is evident that during the dry season, positive parasitaemia rate was lower in each community (range: 12.4 to 44.2 percent) than that for the rainy season (range: 28.3 to 53.7 percent). The average parasitaemia rate during the dry season for the four communities was 22.7 percent, while the rate for the rainy season was 41.6 percent. During the dry season, there were 126 children (15.07 percent) with palpably enlarged spleen out of the 836 children studied. Thus, the spleen rate was 15.07 percent. During the rainy season, the number was 186 children out of 882 children; therefore, the spleen rate was 21.09 percent. Thus, the parasitaemia and spleen rates, respectively, were higher in the rainy season than the corresponding rates in the dry season.

Table III

Parasitaemia and Splenic Rates during both Seasons

Community	Dry Season		Rainy Season	
	Parasitaemia Rate (%)	Spleen Rate (%)	Parasitaemia Rate (%)	Spleen Rate (%)
Jengre	18.7	20.5	48.6	17.0
Amo-Katako	44.2	21.1	35.6	34.7
Foron	12.4	11.7	53.7	19.6
Toro	15.6	5.2	28.3	8.2

Table III compares the parasitaemia and spleen rates during the dry and rainy seasons respectively, among children in individual communities. While the spleen rate during the dry season ranged between 5.2 and 20.5 percent, the range in the rainy season was between 8.2 and 34.7 percent. The

calculated AES (Table IV and V) during the dry season ranged from 0.07 in Toro to 0.4 in both Jengre and Amokatako. The range in the rainy season was from 0.1 in Toro to 0.6 in Amokatako.

Table IV

Calculated Average Enlarged Spleen (AES) during the Dry Season

Spleen Class	Jengre		Amo-Katako		Foron		Toro	
	No. of Children B1	AxB ₁	No. of Children B2	AxB ₂	No. of Children B3	AxB ₃	No. of Children B4	AxB ₄
0	161	0	195	0	146	0	208	0
1	18	18	13	13	10	10	8	8
2	13	26	27	54	8	16	4	8
3	8	24	7	21	1	3	0	0
4	3	12	5	20	1	4	0	0
5	0	0	0	0	0	0	0	0
Total	203	80	247	108	166	33	220	16
	AES = 0.4		AES = 0.4		AES = 0.2		AES = 0.07	

AxB = Index of spleen volume

$$AES = \frac{AxB}{B} = \frac{\text{Cumulative spleen volume}}{\text{no of children studied}}$$

Table V

Calculated Average Enlarged Spleen (AES) during the Rainy Season

Spleen Class	Jengre		Amo-Katako		Foron		Toro	
	No. of Children B1	AxB ₁	No. of Children B2	AxB ₂	No. of Children B3	AxB ₃	No. of Children B4	AxB ₄
0	168	0	176	0	153	0	199	0
1	15	15	45	45	21	21	7	7
2	18	36	37	74	11	22	11	22
3	1	3	10	30	6	18	0	0
4	1	4	3	12	0	0	0	0
5	0	0	0	0	0	0	0	0
Total	203	58	271	161	191	61	217	29
	AES = 0.3		AES = 0.6		AES = 0.3		AES = 0.1	

AxB = Index of spleen volume

$$AES \text{ for each locality} = \frac{AxB}{B}$$

Discussion

The size and shape of the spleen vary according to age, exercise and presence of disease conditions such as malaria; it shrinks remarkably after death.⁸ Weight for weight, the spleen has a ratio of 1:263 of the body weight which is about 76gm for a 20kg child and 266gm for a 70kg adult.⁸ The spleen must double its size to be visibly enlarged.⁹ In non-malarious regions, the spleen is palpable in one to five percent of children and in low endemic malarious regions, it is palpable in up to 10 percent.⁹ With a spleen rate of 15.07 percent in the dry season and 21.09 percent during the rainy season, Jos and its environs fall within moderate endemic malarious region, but with seasonal variation in its prevalence. Considering the various communities in isolation and using the AES, it is evident that there was not much seasonal variation in prevalence in Jengre and Toro communities, whereas the prevalence in Foron and Amokatako communities showed significant upsurge during the rainy season. This means that patients coming for major surgery from such regions are likely to require malaria prophylaxis during the rainy season. Within the age limit of two to 14 years surveyed, there was no noticeable predilection for increased parasitaemia by any given age groups. The parasite rate among 316 consecutive surgical admissions to the paediatric surgical unit, JUTH, was 11.7 percent with a spleen rate of 8.37 percent (unpublished observation). With such a parasite index in this capital city, there is no doubt that Jos and its environs belong to a low to moderate endemic malarious region of Africa. There are focal regions of epidemic upsurge in the rainy season period and special attention has to be directed to the inhabitants of such regions during the wet months of the year.

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