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Seasonal Pattern of Malaria Fever Among Children in Abeokuta, Ogun State, Southwest Nigeria

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Abstract: Investigations were conducted on the aspect of seasonal pattern of malaria infection in Abeokuta, the capital city of Ogun State located in the forest zone of Southwest Nigeria. Using longitudinal study, blood samples were examined in children < 15 years, for malaria parasitaemia, Seasonal variation in malaria fever and mosquito abundance were investigated. Observations from the longitudinal study carried out between October 2000 and September 2001 showed that of the 3,997 feverish cases recorded 82.4% was due to malaria. Fever and malaria were significantly higher in the wet than the dry season (P < 0.0001). Fever significantly correlated with malaria all year round (P = 0.0005). Of the 3290 mosquitoes caught by human bait between September 2001 and August 2002, 48% were Anopheles species, while 88% of the*Anopheles* species was *An. gambiae*.This species is considered the main vector in the study area. Mosquito abundance was significantly higher in the wet than dry season (P < 0.0001), while the mean biting density was higher in the high density than low density areas of the city (P < 0.0001). Also mosquito abundance significantly correlated with rainfall (P = 0.002) and relative humidity (P = 0.01) but not with temperature (P = 0.745).

Key words: Malaria, Fever, Mosquito, Seasonal

Introduction

Although malaria has been recognized for thousand of years, it is only within the last hundred years that the malaria parasites were discovered and the part played by mosquito recognized. The first malaria parasite was recognized in Africa by La Veran, a Frenchman, who found the parasites in the blood of patients suffering from the disease in 1880. He called it "GERMS OF MALARIA". In 1898, Ronald Ross showed that the mosquito was the connecting link that carried the parasite from man to man. The entire complex life cycle was recently elucidated (Mackay, 1965).

Malaria, being the greatest scourge of man, a running battle has been waged on the parasite and its mosquito vectors since early part of the last century. At this time about 1,500 million people estimated to live in malarious areas, but half-way through the century, the annual world total of malaria cases was put at 250 million, 2.5 million of them ending in death. By the 1970s, although malaria was still regarded as the greatest killer of man, the various malaria eradication and control programmes had been so successful that over 800 million people were no longer at risk of malaria, however 250 million still remained exposed, 1.5 million of them ending in death. The situation has changed very little in Africa where, if there has been any concerted effort at malaria control at all, it has been at a rudimentary level. This is because of financial, administrative, manpower and technical constraints. At present 240 million African are still not covered by any meaningful malaria control programme and malaria is responsible for 10 percent of the attendance at hospital and still accounts for one million death of infants and children annually (Ukoli, 1990).

Malaria is caused by the protozoan parasites of the genus Pasmadium of which four species infect man. The serious infections are caused by Plasmodium falciparum The other species which infect man are *P. vivax, P. malarial* and *P. ovale.* During the life cycle, the malaria parasite passes through distinct stages in its human and mosquito hosts. In the mosquito host, sexual cycle (male and female gametocytes) called sporogony occurs. In the human liver, exocrythrocytic stage occurs and in the blood stream asexual cycle called schizogony is observed (Brown, 1975).

Malaria is widespread in many parts of the world mainly in the tropical and subtropical countries and transmission occurs in many temperate regions. Malaria is one of the leading causes of morbidity and mortality in Africa. Like most other parasitic diseases, a number of factors determine the epidemiology of malaria disease. This include factors related to the vector, environment, climate and man (Brown, 1975). Also Mouchet (1998) observed that malaria transmission is influenced by inter-related factors such as temperature, humidity, rainfall pattern and behaviour of human population. The majority of Nigerians live in rural areas and malaria consistently ranks among the five most common causes of death in all ages.

Body temperature measurement is an important part of routine clinical examination. Its pattern in conjunction with other clinical feature may be of predictive diagnosis of certain disease. In malaria, fever is an important symptom. Although its pattern in this disease may vary, considerable emphasis has been placed on the relationship between body temperature and the presence of malaria parasitaemia in endemic area (Delfini, 1973; Burce-Chwatt, 1985, Salako *et al.*, 1990). In these areas, surveys of parasite incidence, fever and rainfall pattern are malariological indices that are readily assessed and are useful in planning strategies for malaria control. In Nigeria it is a common practice in the health institutions to start treatment of malaria whenever a patient complains of fever, perhaps due to the endemicity of the disease. In view of these, this study aim to investigate seasonal variation of malaria of malaria fewer in Abeokuta metropolis in the southwest of Nigeria.

Materials and Methods

Study Area: The study was conducted in Abeokuta, the capital city of Ogun State, Nigeria. Abeokuta is an historic Yoruba city founded by the Egbas. The town is surrounded by large masses of rocks and hence also known as the "ROCK CITY". It has a population of about one million. Abeokuta is in the tropical main forest zone of southwest Nigeria. Abeokuta falls within longitude 3^{o} 21' East and latitude 7^{o} 11' North. The annual temperature range from 22.8^{o}C to 34.9^{o}C. The mean annual rainfall is about 107.3mm.

The traditional areas are predominantly in the heart of the town, and are characterized by poorly constructed houses and haphazardly located. These were designated High Density Areas (HAD). On the other hand, the newer areas represented by the estates are better planned with fewer houses per unit of area. They were designated Low Density Areas (LDA).

Methods: Eight communities within Abeokuta metropolis were chosen for the study, five were from the HAD while the other three were from the LDA. From each of the communities, all houses lying within an area of 2,500m,(Bruce-Chwatt, L. J., 1985). were enumerated. Thereafter, 50% and 75% of the houses in the HAD and LDA were respectively selected randomly using their Primary Health Centre (PHC) numbers. All children aged between 1 year and 15 years in each of the selected houses were subsequently enumerated for the study.

Subsequently between October 2000 and September 2001, a monthly house to house visit was made to the selected houses during which each child presenting with fever (temperature > 37.5^{o}C) and headache had his/her blood taken, thick and thin smears prepared, stained with Giemsa solution and examined for *Plasmodium* species.

Biting mosquitoes were collected on two human baits sitting outdoors between 1900 hours and 2200 hours once a week in the selected communities.The collections were for the period of twelve months, covering two seasons (September 2001 to August 2002). All mosquitoes were classified into species using appropriate keys (Gilliet, 1972). Only Anopheles species caught were of interest. The Anopheline density was calculated by the average number of adult female Aneopheles of a given species caught in the human bait expressed as number of bites per person.

Data Analysis: Monthly incidence of malaria cases with respect to feverish condition were calculated. Analysis was carried out on differences in infection by season using Epi info 2000 and SPSS 8.0 for window packages. Correlation analysis and simple logistic models were used to examine the relationship between malaria and fever.

Results and Discussion

One thousand one hundred and nine (1109) children in 592 households were longitudinally investigated between October 2000 and September 2001 (Table 1) using fever as indicator. Of these, male children accounted for 633 (57.1%) and female 476 (42.9%). Also children aged 0 – 5 year constituted 356 (32.1%) of the sample, while those aged 6 – 10 years and 11 – 15 years were 478 (43.1%) and 275 (24.8%) respectively. A total of 3997 feverish conditions were recorded during the screening, of which 3294 (82.4%) were diagnosed as due to malaria; overall, the mean number of fever symptoms was 331.8 for the period of the study. The monthly incidence of malaria and fever is shown in fig. 1. The incidence of malaria and fever were higher in the wet than dry seasons.

Correlation analysis was carried out to examine the relationship between fever and malaria and then further stratified by season. The output from this analysis is shown in Table 2. There was a positive linear and significant relationship between malaria and fever all year round (P = 0.0005), the strength of the association being 99%. When the relationship was stratified by season, it was more significant in the wet (April – October) than the dry season (November – March).

In determining the crude transmission rate of malaria parasites during the dry and wet season, the gametocyte rate was determined (Table 3). The result showed that out of 731 cases of malaria infections during the dry season, the gametocyte rate was 35 (4.8%) while it was 70 (2.7%) during the dry season. The peak of gamecytopaenia was in the month of November 23 (11.3%). Also the frequency distribution of Plamodium species seen in blood shows that of the two species (Table 4), *P. falciparum* (89.7%) was significantly more encountered than P. malariae (10.3%). There was no *P. vivax nor P. ovale* found nor was there any mixed infection of *P. falciparum* with *P. malariae.*

A total of 3290 mosquitoes were collected from September 2001 to August 2002 by human bait catches between 1900 and 2200 hours in the study areas of this number, Anopheles species formed 48% of the total catch. Among the Anopheles species, An. gambiae sl. was the most common (88%). Other Anopheles species encountered were An.

pharoensis (10%) and An. squamosus (2%). The seasonal variation in the biting density of mosquitoes is shown in Fig. 1. the density was highest in the raining months and least in the dry season. The abundance of Anopheles species also followed this general pattern. Significantly more mosquitoes were caught in the high density than low density areas ($P < 0.0001$). Also significantly more bites per man was received in the former than the later (Fig. 2). The relationship between rainfall humidity and temperature with mosquito abundance is shown in Fig. 3. There was a positive and significant correlation between mosquito abundance with rainfall ($r = 0.79$, $P = 0.002$) and relative humidity ($r = 0.71$, $P = 0.01$) all year round but not with temperature ($r = 0.11$, $P = 0.745$).

Results and Discussion

Many health providers, particularly in the rural areas use the presence of fever or history of fever for clinical diagnosis of malaria where laboratory facilities does not exist. In this aspect of the study, fever cases for malaria were increased. The incidence of malaria and fever were higher in the wet than the dry seasons. The wetter months may have enhanced mosquito vector breeding and hence an increased malaria transmission. A high and significant association was recorded between fever and malaria in both the wet and dry seasons, indicating fever as a good predictor of

Table 1: Distribution of households and children examined for fever in the study areas

S/No	Zone	Number of household enrolled	Number of children	Number of cases reported
1	Elega	38	86	354
2	Asero	55	73	324
3	Idi-Aba	42	88	337
4	Iberekodo	84	119	470
5	Ake	67	79	358
6	Sabo	149	286	940
7	Isabo	68	135	430
8	Igbore	89	243	784
	Total	592	1109	3997

Table 2: Correlation coefficients for the relationship between fever, malaria and typhoid infections

Season	Variables	Correlation coefficient (R)	R square	Std. Error	P values	95% confidence interval for R square
Overall	Malaria/fever	0995	0.990	14.2066	0.0005	0.96 – 1.00
Dry	Malaria/fever	0.933	0.871	15.4777	0.010	-0.05 – 0.99
Wet	Malaria/fever	0.995	0.990	9.6967	0.0005	0.93 – 1.00

Table 3: Seasonal variations in gamecytopaenia

Months	Dry season			Months	Wet season		
	Total no. of malaria cases	Gametocytes			Total no. of malaria cases	Gametocytes	
		Positive	Negative			Positive	Negative
November 2000	204	23 (11.3%)	181 (88.7%)	October 2000	233	23 (9.9%)	210 (90.1%)
December 2000	163	9 (5.5%)	154 (94.5%)	April 2001	267	8 (3.0%)	259 (97.0%)
January 2001	126	1 (0.8%)	125 (99.2%)	May 2001	385	1 (0.3%)	384 (99.7%)
February 2001	124	1 (0.8%)	123 (99.2%)	June 2001	413	9 (0.3%)	404 (97.8%)
March 2001	114	1(0.9%)	113 (99.1%)	July 2001	472	12 (2.5%)	460 (97.5%)
Total	731	35 (4.8%)	696 (95.2%)	August 2001	442	9 (2.0%)	433 (98.0%)
				September 2001	351	8 (2.3%)	343 (97.7%)
				Total	2,563	70 (2.7%)	2493 (97.3%)

$X^2 = 35.340$, $P < 0.0001$

Table 4: Frequency distribution of Plasmodium species in blood samples

Plasmodium species	Frequency	Percent (%)
Plasmodium falciparum	3585	89.7
Plasmodium malariae	412	10.3
Total	3997	100

$X^2 = 20.904$, $P < 0.0001$

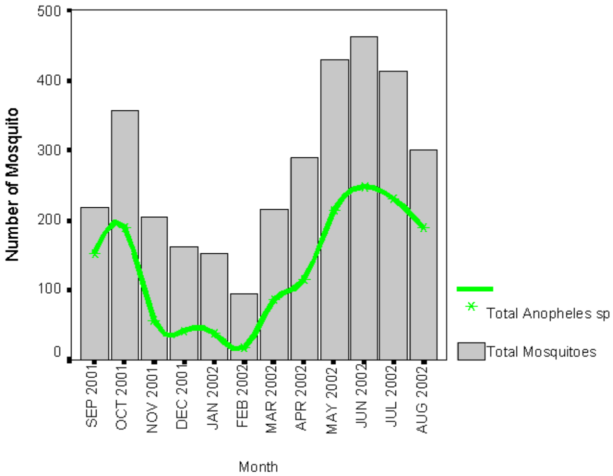

Fig. 1: Abudance of mosquitoes caught by human baits

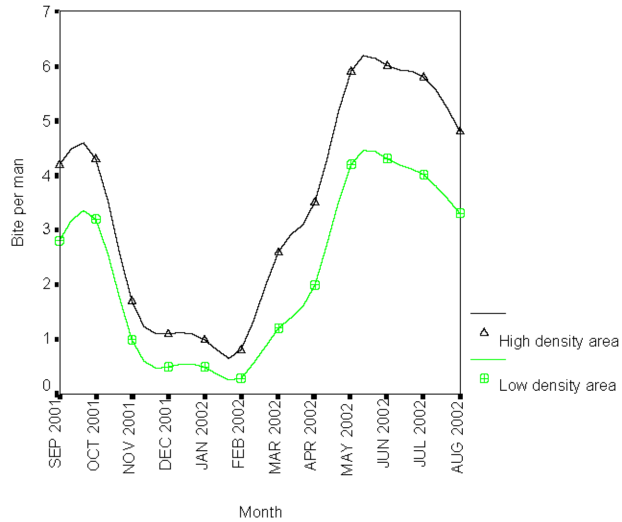

Fig. 2: Mosquito bite per ma in high and low density communities

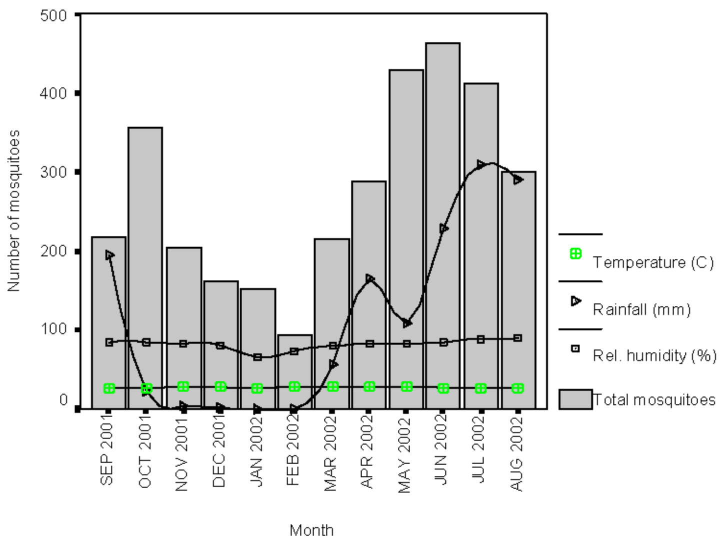

Fig. 3: Relationship between weather conditions and mosquito abundance

malaria. Although this finding is supported by other studies (Defini, 1973; Ejezie and Ezedinachi, 1992; Genton *et al*, 1991; Muhea *et al*, 1999; Rowe *et al*, 2000), elsewhere, body temperature has also been shown to be a poor predictor of malaria parasitaemia in children with acute diarrhoea (Gbadegesin *et al*, 1997) and in areas of low transmission (Chandranmohan *et al*, 2001; Daniel *et al*, 1992). This is because malaria diagnosis require laboratory tests to be accurate in these areas (Chandranmohan *et al*, 2001). However, due to potential fatal nature of malaria, it has been suggested that for areas with high malaria risk, any child with fever or recent history of fever should be treated with anti-malaria drugs even if other causes of fever are present (Marsh *et al*, 1996; Goves, 1997).

Within the study area, significantly lower occurrence of fever and malaria was obtained in the low density than high density areas in both the dry and wet seasons. This may be attributed to a greater use of personal antimosquito measures such as window and door nets, which reduce mosquito bites and in turn transmission. Also the environment of the estate were better maintained which could help reduce mosquito breeding. Also in a semi-urban community in southeastern Nigeria, Eneanya (1998) recorded 62.9% prevalent with a greater proportion occurring in the wet season.

The occurrence of gamecytopaenia in this study, though similar to that obtained in Sagamu (Ogunledun *et al*, 1990) in both the wet and dry season, was much lower than 20.94% obtained in Awka by Eneanya (1998) in wet months. The prevalence of these sexual form in blood is indicative of active transmission. As noted previously, transmission is suspected to be by Anopheles gambiae which formed over 70% of all Anopheles species in the human traits all year round. Malaria has been thought to exist where effective Anopheles vector breeds in nature and where human carriers of the sexual forms of the parasite are available to these vector (Eneanya, 1996).

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