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SEASONAL VARIATION OF MALARIA PARASITAEMIA IN AN URBAN TROPICAL CITY

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ABSTRACT:

There is a dearth of information on seasonality of malaria parasitaemia in Benin City, Nigeria. Our objective was to determine the seasonal prevalence of malaria (if any) in order to assist health policy makers. We studied malaria parasite requests over a twelve-month period: January to December 2001, in order to include the two main seasons in this part of the world. These seasons include the wet season, which is from May to October, and the dry season, which is from November to April. We extracted all the relevant data on malaria parasite requests from a special register designated, 'Malaria Parasites Only' from the Medical Microbiology Laboratory of the University of Benin Teaching Hospital, Benin City. A total of 2968 requests for Malaria parasite were made during the period out of which 1806 (60.85%) were positive. Of the 1806 positive samples, 72% were found in the under 5 years of age. Malaria parasitaemia was found throughout the year. There were no obvious differences between the wet and dry seasons though the highest peak of malaria parasitaemia coincided with the height of raining season (Pearson's correlation co-efficient was –0.33). Three different species of Anopheles mosquitoes could be responsible for malaria transmission at different times of the year in this environment. Various environmental and economic factors may ensure enhanced vector-parasite relationship, thus explaining the perennial transmission of malaria parasites to man. We demonstrated clearly the perennial nature of malaria infestations in Benin City though it tends to more prevalent in the height of raining season. This finding, therefore, calls for a timeless but vigorous preventive measures all year round.

KEY WORDS: ***Malaria parasitaemia, seasonality, Benin City, Nigeria***

INTRODUCTION

Benin City is a cosmopolitan town and the capital city of Edo State of Nigeria. This city accommodates over a quarter of the estimated 3.5 million people occupying about 10% of the entire landmass of the state. It is mainly a Civil Service town with few industries. It is a moderately urbanized town in a tropical rain forest region with exuberant vegetative growths of plants and weeds. There are two main seasons. The wet season is usually between the months of May and October while the dry season is from November to April.

Apart from the availability of water, other factors like optimum temperature seems to favour mosquito breeding throughout the year[2]. In particular the world's most efficient plasmodia vector the Anopheles gambiae complex (which is the commonest specie in the sub-Saharan Africa), has high degree of anthropoolism (close association with man), and it is known to breed in and around houses[2,3].

It is well established that climate is an important determining factor in the spatial and temporal distribution of vectors and pathogens.[3] In theory, a change in climate would be expected to affect the geographical range, seasonality (intra-annual variability), and the incidence rate of transmissible diseases[3,4,5,6,7] The vector-disease relationship, and the anthropogenic climate changes remain emerging tasks for scientists[3].

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While some workers believe that there is lack of strong evidence for the impact of climate on vector borne diseases like malaria, dengue, Leishmaniasis, tick diseases etc,[2] others seem to favour seasonal prevalence especially of Plasmodium falciparum[6,7,8,9,10].

For instance a study in Brazil found that a reduction in a particular specie of Anopheles darlingi in a particular geographical area can sometimes cause disappearance of malaria transmission at different times of the year[11,12].

Though Benin City is endemic for malaria infection, seasonal prevalence to our knowledge is yet to be studied. Our goal is to ascertain the period of the highest malaria parasitaemia in order to determine the period of maximum preventive impact on malaria.

METHODS:

Data were extracted from the records of all malaria parasite requests made between January and December 2001. All such requests and results are carefully entered into a special register designated, 'malaria parasites only' at the Medical Microbiology Laboratory (parasitology section) of the University of Benin Teaching Hospital, Benin City.

The parasitology unit of our laboratory employs a 3% Giemsa solution in pH 7.2 distilled water for staining a thick blood film. Usually, a thoroughly air dried (but unfixed) thick blood film is flooded with the stain for 5 to10 minutes and then flushed off with drops of clean water.

When dried, the slide is then examined under oil immersion.

A simple but reliable "plus system" of enumerating parasite density according to World Health Organisation (1985) is used. All results whether positive (+ to ++++) or negative (0) are entered into our register.

RESULTS

A total of 2968 requests for malaria parasite were made during the index period, January to December 2001. A total of 1187 (40%) were males and 1439 (46.27) were females. Three hundred and forty had no gender categorization.

Table 1 shows the demographic characteristics of the patients while Table 2 shows the cumulative malaria parasitaemia under various age strata. The parasites yield is 1806 (60.85%). Children under 2 years of age represented 36.4% of total malaria parasites requests, and accounted for 46% of the total parasite yields. Cumulatively, under 5 years of age accounted for 50.4% and parasites yield of 72%, under 10 represented 61.9% and malaria parasites yield of 81.3% and under 16 years of age represented74.7% and malaria parasite requests accounting for 89.9%, while > 16 – 73years accounted for the remaining 25.3% and malaria parasites yield of 11.1%.

Table 1: **Demographic distribution of malaria parasites requests**

Age(years)	Male	Female	No gender identity	Total
<2	403	514	163	1080
<5	163	99	79	341
5-9	151	171	58	380
10-14	199	179	08	386
15-19	112	140	13	265
≥20	159	336	21	516
Total	1187	1439	342	2968

Table2: **Cumulative prevalence of malaria parasitaemia**

Age(years)	Cumulative positive samples	Negative samples	Total
<2	831	249	1080
<5	1300	121	1421
<10	1468	333	1801
<16	1544	644	2188
All ages	1806	1162	2968

Fig 1: is a simple histogram showing the monthly distribution of malaria parasite requests as well as the results for the 12-month period. The highest requests were in the months of July, August and September and represent 1252 (42.18%). This period showed the highest malaria parasites demonstration, which is more marked in the month September. The month of June showed the lowest requests.

Figure 2 compares malaria parasitaemia during the two well defined seasons. This also shows that malaria parasitaemia is

Figure 1: **Monthly Variation Of Malaria Parasitaemia**

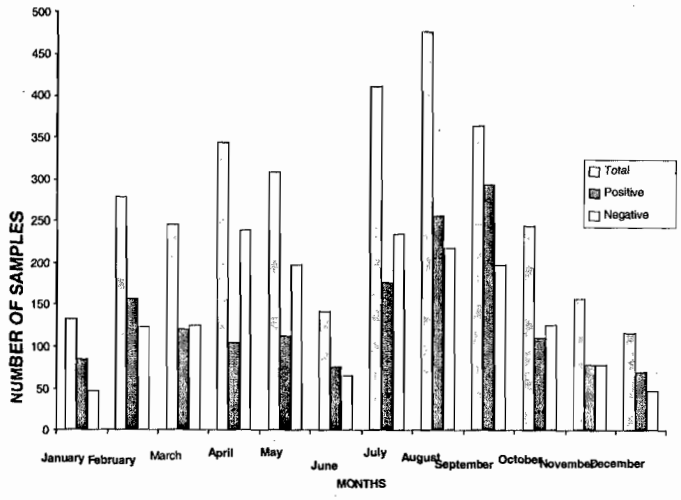
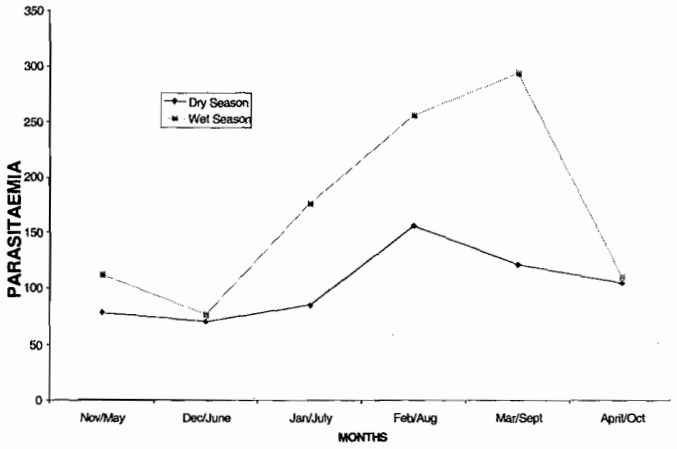


Figure 2: **Malaria Parasitaemia durng Dry and Wet Seasons**



found to a variable proportion throughout the year in Benin City: The overall malaria parasites prevalence during the wet season (between the months of May and October) is 56.7% of the annual malaria parasitaemia. The dry season on the other hand is between November and April, and accounted for 43.3% of demonstrable malaria parasites. The height of raining season (July - September) accounted for 40.3% of the demonstrable malaria parasites.

Paired sample t-test (with α level at 0.05) failed to show any significant difference between the two seasons ($p = 0.51$). Pearson's coefficient of correlation was -.33 indicating a very weak negative relationship between malaria parasitaemia and the two seasons.

DISCUSSION:

We report malaria parasitaemia fluctuation throughout the year without any clear pattern and re-emphasis it's endemicity devoid of seasonality. Though a clear higher occurrence of malaria parasites was recorded during the months of August and September (which coincided with the height of raining season), there is no obvious difference, overall, between the wet and dry

season (P = 0.52). For instance only little difference may be noticed during the months of March/April, which marked the end of the dry season compared with May and October, which marked the beginning and ending of the raining season respectively.

There have been controversies regarding seasonal variability reported in most malaria endemic countries. While a clear seasonality has been established by some authors[4,6, 13, 14], some other were unable to demonstrate any seasonal impact on malaria prevalence.[15, 16] Our findings for lack of seasonality is in consonance with those of Smith J et al [15] and others[16]. Similarly, many reports emanating from Asia and certain African countries showed no variability in malaria parasitaemia attributable to seasons in spite of fewer mosquito bites during the dry season[15,16,17].

In contrast to our findings, however, other reports strongly support seasonal tie with malaria parasitaemia[6-10, 18,19,20]. Indeed, some anonymous authors posited that, "marked seasonality and the quasi-cyclic occurrence of heavy rains lead occasionally to epedemic or serious exacerbation of malaria parasitaemia in sub-sahara Africa" [21].

The inability of this study to demonstrate any seasonal variability of malaria parasitaemia may be related to a number of factors. These may include lack of regular portable water supply and the storage habits necessitated by this lack on one hand. On the other hand, poor drainages (which reflects the neglect of social amenities by successive governments) may also be contributory. The combination of these factors ensures adequate uninterrupted ecological habitat of Anopheles species of mosquitoes and infectious reservoir of plasmodium species. Such habitats include storage of water in any available container in and around the house. Furthermore, it is usual to find gutters turned into stagnant ponds, and over grown with weeds. Economic plants, like plantain, banana or Cocoyam are found very close to house. These plants are favourable breeding habitats for certain mosquito species. Furthermore, poor knowledge of health promoting behaviour coupled with poverty may also contribute significantly to endemicity of malaria in Nigeria. The economic consequence of these practices may be difficult to quantify[22].

Some authors speculated that the lack of periodicity of malaria parasitaemia might be due to the fact that different species of Anopheles mosquitoes have different peak of fecundity. The efficiency of blood meals by Anopheles *funestus* for instance has two peaks during the year, one in March and the other in September/October[17].

Nigeria is known to habour multi-species and multi-clonal plasmodial infections[19]. In order to further evaluate the in apparent malaria parasites periodicity, it may be necessary determine plasmodia species periodicity if any vector control is to be attempted.

Our opinion is that three major species of Anopheles mosquito may be responsible for plasmodia species transmission as suggested by figure 1. One species may be found commonly from November-January, the second from February to May, and the third commence about June and peaks in September. It is also possible that these species may have ecological preferences

We conclude that malaria parasitaemia is not seasonal though the peak finding coincided with the peak of wet season. Several factors including neglected environment may contribute to the emergence and proliferation of different vector species. Ecological disturbance of breeding sites ensured by provision of regular pipe borne water and good drainage could reduce plasmodial infections and morbidity.

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