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PREVALENCE OF MALARIA AND TYPHOID INFECTIONS IN ENDEMIC COMMUNITY OF OGUN STATE, NIGERIA

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ABSTRACT

Investigations were conducted on aspect of the prevalence of malaria and typhoid infections in Abeokuta, the capital city of Ogun State located in the forest zone of southwest, Nigeria. Using the cross-sectional study, blood samples were examined in children <15 years for malaria parasitaemia, Widal serologic reactions and other haematological parameters (PCV, Hb, ABO system, Rh factor and Hb genotype). The overall prevalence of malaria infection was 59.9% (*Plasmodium falciparum* accounted for 89.7% and *Plasmodium malariae* 10.3%) and females were significantly more infected (64.3%) than males (56.1% (P = 0.05); so also were children aged 0 - 5 years were infected (83.1%) than other age groups. More children were infected in the high density areas (64.3%) than low density areas (46.4%) (P = 0.235). There were significant differences in malaria infection among the various Hb genotypes (P < 0.0001). Also malaria was significantly higher among children with severe aneamia (P < 0.0001). However there was no significant difference between malaria infection among the different blood groups (P = 0.357) and in Rhesus antigen (P = 0.4390). Gametocytopaenia was 7.9% and was significantly higher among the youngest age group (P < 0.0001). Parasite density increased with increasing body temperature (P < 0.0001). The prevalence of typhoid infection was 17.4% but did not differ between sexes (P = 0.8522) although significantly higher among older children (P = 0.0001). Among 500 blood and stool samples respectively screened for Widal agglutination reaction and stool cultures, growth was recorded in 54.5% and 100% of samples with titre values 1:160 and 1:320 respectively.

Keywords: Malaria, Typhoid infections, Endemic community and Ogun state.

INTRODUCTION

Although malaria has been recognized for thousands of years, it is only within the last hundred years that the malaria parasites were discovered and the part played by mosquitoes 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. 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 is widespread in many parts of the world mainly in the tropical and subtropical countries and transmission occurs in many temperate regions. However, it is highly distributed in African countries especially along the equatorial region that favour the growth of mosquitoes. In Northern Africa, the low incidence may be due to the dry Sahara desert.

Malaria is one of the leading causes of morbidity and mortality in Africa. Malaria infection is one of the major health problems that require concerted attention and control measures. Malaria infection as the most commonly reported disease in Nigeria had been established in urban and rural communities in seemingly healthy individuals examined (Ademowo *et al*., 1995). It is estimated that the prevalence of malaria parasitaemia among Africans is about 80 percent. Nigeria being a tropical country experiences a high degree of such parasitaemia. The majority of Nigerians live in rural areas and malaria consistently ranks among the five most common causes of death in all age groups (Eneanya, 1998).

Malaria and typhoid fever have overlapping signs and symptoms. The high prevalence is established fact that an unusually high number of illness have been diagnosed as malaria co-existing with typhoid fever (Ammah *et al.*, 1999). 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 aims to investigate aspects of the epidemiology of malaria and typhoid infections in Abeokuta city in the south west of Nigeria.

MATERIAL AND METHODS

The study was conducted in Abeokuta, the capital city of Ogun State, Nigeria. Abeokuta is in the tropical rain forest zone of south western Nigeria. 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 (HDA). 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). Five communities within Abeokuta metropolis were chosen to HDA and LDA. From each of the communities, all houses lying within an area of 2500m², were enumerated. Thereafter, 50% and 75% of the houses in the HDA and LDA were respectively selected randomly using their Primary Health Centre (PHC) numbers. All children aged below 15 years in each of the selected houses were subsequently enumerated for the study. Generally the HDA are characterized by poor-quality housing, poor infrastructure and environment whereas the reverse is true of the LDA.

For cross-sectional survey, venous blood was collected from each of the subjects in only 5 of the communities to represent high and low density areas between July 2000 and September 2000. This was used to determine the prevalence of the pre-patent malaria as well as some heamatological parameters such as Packed Cell Volume (PCV) or Haematocrit (HCT), Haemoglobin (Hb) concentration, Blood Group and Haemoglobin genotype. The remaining blood samples were processed for serological assay of Widal reactions for typhoid fever.

The titre value of ≥ 1:160 for Widal reaction is used as the bottom line for treatment of typhoid fever by the physicians in this locality. Therefore stool culture was also undertaken to determine a more appropriate benchmark for treatment in this locality. 500 random blood and stool samples were collected in the study areas and processed to determine *Salmonella* species growth in stool of individual with serologic Widal positive reaction. Each stool sample was pre-cultured in selenite F broth incubated at 37°C for 4 hours and then sub-cultured on MacConkey agar overnight at 37°C for isolation of *Salmonella* species. The growth of a tiny, transparent non-lactose fermenter colonies that was gram negative bacilli, negative for lactose, sucrose and urease but positive for glucose and hydrogen sulphide was considered positive for *Salmonella* infection.

Finally, for the cross sectional studies carried out for the three months (July 2000 - September 2000), the proportion of individual infected with malaria and typhoid were calculated in the areas.

RESULTS

The prevalence of malaria infection by sex in the different study communities is shown in Table-1. Of 305 (53.7%) males and 263 (45.3%) females examined, infection in male ranged from 40.6% - 80.0%, while in female it ranged from 43.5% - 90.3%. On the whole more females were infected (64.3%) than males (56.1%). When the prevalence was grouped into low and high density communities (Table - 2), although infection was lower in the former (46.4%) than the latter (64.3%), there was no significant difference.

With respect to age, infection decreased significantly with increasing age (table 3a), being highest in children below 5 years (83.1%) and lowest among the 11 - 15 year age group (34.1%). Overall, the prevalence of infection in the study area was 59.9%. Table 3b shows that 75.9% of the houses examined were without mosquito nettings on their windows or doors. The table also showed that the prevalence of malaria infection was significantly higher in those households without window nets (65.9%) than in those with nets (40.9%). Among the 568 children, most were found to belong to blood group O (72.9%) while the least was AB (2.1%) (Table - 4a). Also, most of the children were Rh (D) positive (Table - 4b). However, there was no significant difference in infection between children with different blood groups, nor in the Rh groups. The distribution of the haemoglobin genotypes is shown in Table -5. It shows that 80% of the subjects belong to genotype AA, which also was significantly more infected (69.3%) than other genotypes. No infection was seen among Hb SS children.

The frequency distribution of malaria parasites in relation to the PCV is given in Table- 6.

A majority of the subjects (64.1%) had moderate, but below normal PCV while 5.5% had severe anaemia. It could also be observed that the prevalence of malaria was highest among children with severe anaemia (80.6%) and moderate PCV (77.9%) but least among those with normal PCV. The gametocyte rate for the study population was 7.9%. There was significant difference between children of different ages (Table -7). The frequency distribution of *Plasmodium* species seen in blood smears shows that, of the two species (Table -8), *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*.

The overall prevalence of typhoid fever in the different sites was 17.4% while the typhoid fever that coexist with malaria was 41 (7.2%). No significant differences was observed between the different sites, nor was there any between the sexes (Table 9a). When the study sites were grouped into low and high density areas, no significant difference was also seen (Table -9b). However when prevalence was stractified by age, there were significant differences, being highest among the oldest children and least among the youngest (Table -9c). For the 500 stool and blood samples randomly selected subjects cultured for *Salmonella* growth and serological Widal test conducted during the dry months. *Salmonella* was isolated from 32.8% of the stools while 39% were Widal positive. However growth occurred in 54.5% of serum titre 1:160 and 100% in 1:320 agglutination (Table-9d).

DISCUSSION

This study showed an overall prevalence of 59.9% malaria parasitaemia in Abeokuta, although with differing levels in the different study sites within the study area. Within the study area, significantly lower prevalence was obtained in the low density than the high density areas. 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 estates were better maintained which could help reduce mosquito breeding. The higher level of education coupled with their socio-economic status associated with these residents of the low density areas may also have ensured regular use of insecticides and other mosquito measures. The high density areas in contrast with poorly constructed houses, lacking in window and door screens, may have increased man-vector contact and hence the higher malaria infections. Varying prevalences have also been

Table - 1: Distribution of malaria by sex in the selected communities in Abeokuta

Sex	Communities (malaria positive) Elega n = 73	Idi-Aba n = 67	Sabo n = 200	Isabo n = 71	Igbore n = 157	Grand total n = 568
Males	13/32 (40.6%)	24/44 (54.5%)	45/105 (42.9%)	32/40 (80.0%)	57/84 (67.9%)	171/305 (56.1%)
Females	18/41 (43.9%)	10/23 (43.5%)	63/95 (66.3%)	28/31 (90.3%)	50/73 (68.5%)	169/263 (64.3%)
Total	31/73 (42.5%)	34/67 (50.7%)	108/200 (54.0%)	60/71 (84.5%)	107/157 (68.2%)	340/568 (59.9%)

$X^2 = 10.284$ $P < 0.05$

Table - 2: Distribution of malaria by sex in the low and high density communities in Abeokuta

Sex	Communities (malaria positive) Low density populated n = 140	High density populated n = 428
Males	37/76 (48.7%)	134/229 (58.5%)
Females	28/64 (43.7%)	141/199 (70.9%)
Total	65/140 (46.4%)	275/428 (64.3%)

$X^2 = 1.413$ $P = 0.235$

Table -3a: Age-prevalence of Malaria infections in Abeokuta

Age (years)	Total number examined	Malaria infection Positive	Malaria infection Negative
0 - 5	183	152 (83.1%)	31 (16.9%)
6 - 10	208	128 (61.5%)	80 (38.5%)
11 - 15	177	60 (34.1%)	117 (65.9%)
Total	568	340 (59.9%)	228 (40.1%)

$X^2 = 91.369$, $P < 0.0001$

Table -3b: Prevalence of Malaria parasite infection in relation to household types

Household types	Total number examined	Malaria parasite infection Positive	Malaria parasite infection Negative
Without nets	431 (75.9%)	284 (65.9%)	147 (34.1%)
With nets	137 (24.1%)	56 (40.9%)	81 (59.1%)
Total	568 (100%)	340 (59.9%)	228 (40.1%)

$X^2 = 27.432$, $P < 0.0001$

Table - 4a: Malaria parasite infection in relation to ABO blood antigenic system

Blood group	Total number examined	Malaria parasite positive
O	414 (72.9%)	247 (59.7%)
A	101 (17.8%)	64 (63.4%)
B	41 (7.2%)	24 (58.5%)
AB	12 (2.1%)	5 (41.7%)
Total	568 (100%)	340 (59.9%)

$X^2 = 8.497$, $P = 0.357$

Table - 4b: Prevalence of malaria in relation to Rhesus D antigen

Rhesus factors	Total number examined	Malaria parasite positive
Rh (D) positive	54 (96.7%)	327 (59.6%)
Rh (D) negative	19 (3.3%)	13 (68.4%)
Total	568 (100%)	340 (59.9%)

$X^2 = 0.60$, $P = 0.4390$

obtained in studies in different parts of Nigeria. For instance Eneaya (1996) reported a prevalence of 81.6% in an urban health center in Enugu. Also in a semi-urban community in southeastern Nigeria, Eneanya (1998) recorded 62.9% prevalence with a greater proportion occurring in the wet season. In the same region, Mbanugo and Ejim (2000) reported a 58% prevalence among children aged 0 – 5 years while Ogunledun *et a.l* (1990) observed 43 in Sagamu in southwestern Nigeria. Elsewhere in the northern part of Nigeria, a lower prevalence of 27.6% was obtained among primigravidae (Fleming *et al*., 1979) and 31.1% and 20% from young children in Zaria (Fleming *et al*., 1985) and (Okoyeh *et al*., 1994) respectively. From the foregoing it appears that the prevalence of malaria infection is often higher in the wetter south than the drier north.

Differences in infection rate between male and female have been variously reported. While prevalence in males were reported to be more than females (Osuhor and Etta 1980; Lege-Oguntoye *et al*., 1989; Okoyeh *et al*., 1994), the reverse reported by Eneanya (1996). In the same vein, Kobayashi *et al*. (2000) observed no difference in prevalence. However, in this investigation, more females were infected than males. Although the reason may not be certain, it may indicate a higher exposure of this group to the vectors, or a lower immune status. The prevalence of malaria parasitaemia was found to be higher in children aged 0 – 5 years than other age groups. This is in line with the findings of Mbanugo and Ejims (2000) and Sowunmi *et al*. (2000) in Nigeria and Afari *et al*. (1995) in Ghana. The high parasitaemia in children acquiring immunity to malaria in early life explains the high prevalence in this age group as compared to other age groups who might have acquired immunity as a result of frequent antigenic stimulation (Afari *et al*., 1995). This finding underscores the need for young children to be effectively protected from transmission using mosquito repellants and impregnated bednets and/or other antimalaria agents.

Table - 5: Prevalence of malaria in relation haemoglobin genotypes

Haemoglobin genotypes	Total number examined	Malaria parasite positive
AA	455 (80.1%)	315 (69.3%)
AC	6 (1.1%)	1 (16.7%)
AS	93 (16.4%)	23 (24.7%)
SC	6 (1.1%)	1 (16.7%)
SS	8 (1.4%)	0 (0%)
Total	568 (100%)	340 (59.9%)

$X^2 = 85.892$, $P < 0.0001$

Table - 6: Prevalence of malaria parasites in relation to packed cell volume

PCV (%)	Children screened		Children with malaria infections	
	Frequency	Percent (%)	Frequency	Percent (%)
35 – 54 (normal)	171	30.1	30	17.5
25 – 34 (moderate)	366	64.4	285	77.9
< 25 (severe)	31	5.5	25	80.6
Total	**568**	**100**	**340**	

$X^2 = 17.415$, $P < 0.0001$

Table - 7: Prevalence of gametocytopaenia in relation to age

Age (years)	Total number of malaria positive	Gamecytopaenia Positive	Negative
0 – 5	152	26 (17.1%)	126 (82.9%)
6 – 10	128	1 (0.8%)	127 (99.2%)
11 – 15	60	0 (0%)	60 (100%)
Total	340	27 (7.9%)	313 (92.1%)

$X^2 = 31.613$, $P < 0.0001$

Table - 8: Frequency distribution of *Plasmodium* species in blood samples

Plasmodium species	Frequency	Percent (%)
P. falciparum	305	89.7
P. malariae	35	10.3
Total	340	100

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

Table - 9a: Prevalence of typhoid fever in the study area

Sex	Communities (Widal reactions positive)					
	Elega n = 73	Idi-Aba n = 67	Sabo n = 200	Isabo n = 71	Igbore n = 157	Grand total n = 568
Males	2/32 (6.3%)	8/44 (18.2%)	23/105 (21.9%)	8/40 (20.0%)	13/84 (15.5%)	54/305 (17.7%)
Females	3/41 (7.3%)	9/23 (39.1%)	18/95 (18.9%)	3/31 (9.7%)	12/73 (16.4%)	45/263 (17.1%)
Total	5/73 (6.8%)	17/67 (25.4%)	41/200 (20.5%)	11/71 (15.5%)	25/157 (15.9%)	95/568 (17.4%)

$X^2 = 0.030$, $P = 0.8522$

The results in this study showed that there was no significant difference between malaria prevalence and ABO system among children (P = 0.3570), although the frequency of malaria parasitaemia among children with blood AB antigen was lower compared to other blood antigens. Previous reports by Osisanya (1968), Raper (1968) and Martin (1979) did not show any difference in the frequency of ABO blood group on malaria infected patients. However, Arthreya and Corriell (1967), Tchuinkam *et al*. (1993), Ademowo *et al*. (1995), Drakeley *et al*. (1999) opined that there was significantly lower parasite rate among those with B antigen when compared with other groups suggesting that the B antigen may confer selective advantage against malaria in endemic areas. This study did not also show that the Rh factor had effect on malaria parasitaemia. The prevalence of sickle cell trait among the children was 16.4%. The figure obtained in this study was lower than those obtained in other reported studies in Nigeria. A prevalence of 24.7% and 25% were reported in Ibadan and Igbo-Ora, southwestern Nigeria by Flemming *et al*., 1979; Achidi *et al*., 1996; 25% and

Table - 9b: Typhoid fever in relation to sex in the high and low density areas

Sex	Communities (Widal reactions positive) Low density populated n = 140	High density populated n = 428
Males	10 / 76 (13.1%)	44 / 239 (18.4%)
Females	12 / 64 (18.8%)	33 / 199 (16.6%)
Total	22 / 140 (15.7%)	77 / 428 (18.0%)

$X^2 = 0.030$, P = 0.8522

Table - 9c: Prevalence of typhoid feverwith age

Age (years)	Total number examined	Widal reactions Positive	Negative
0 – 5	183	15 (8.2%)	168 (91.8%)
6 – 10	208	33 (15.9%)	175 (84.1%)
11 – 15	177	51 (29.0%)	126 (71.0%)
Total	568	99 (17.4%)	469 (82.6%)

$X^2 = 27.712$, P < 0.0001

28.9% in Garki, Kano State, northern Nigeria by Molineaux *et al*., 1979; Flemming *et al*., 1979 and 29% in Benin-city, southern Nigeria by Adekile *et al*., 1988. Partial protection against malaria in Hb AS children was demonstrated in this study as had been explained in the earlier findings of Flemming *et al*., 1979; Molineaux *et al*., 1979; Flemming *et al*., 1985; Adekile *et al*., 1988. Elsewhere, in the Gambia, Tanzania and Cameroon, significantly lower parasite densities and episodes of malaria have also been reported in children with Hb AS compared with Hb AA by Marsh *et al*., 1989; Stirnadel *et al*., 1999 and Hesran *et al*., 1999 respectively. Luzzato *et al*. (1970) had contended that parasitized cells sickled because of oxygen consumption by the parasite and were then phagocytized, hence the lower prevalence in Hb AS. However, at the age of six months and above, Hb AS heterozygote have significantly lower malaria morbidity and mortality (Luzzato, 1979; Flemming *et al.*, 1979; Ademowo *et al*., 1995; Stirnadel *et al*., 1999).

In children, severe anaemia is a common feature of malaria that the degree of anaemia correlates with parasitaemia (WHO 1990). In the report of Achidi *et al*. (1996), which is similar to the findings in this study, malaria parasitaemia

Table - 9d: Prevalence of *Salmonella* in stools of serologic positive Widal positive children

Sample	Negative	1:80	1:160	1:320	TOTAL
Number of serum samples	305	25	165	5	500
Number of stool with *Salmonella* species	100	0	90	5	195
% *Salmonella* isolated in stool	32.8%	0%	45.5%	100%	39%

significantly lowered PCV levels in children. Therefore during hospital visit for suspected malaria cases, the PCV levels of children could be used as diagnostic tool since all children with acute malaria had PCV levels less than 25% (Hb < 8.3g.dL) in this study. This observation also supports the results obtained in the Gambia (Brewster *et al*., 1990; Waller *et al*., 1995), Kenya (Marsh *et al*., 1995; Snow *et al*., 1997), Nigeria (Achidi *et al*., 1996). The prevalence of gamecytopaenia in this study, though similar to that obtained in Sagamu (Ogunledun *et al*., 1990), was much lower than the 20.94% obtained in Awka by Eneanya (1998). The prevalence of these sexual forms in the blood is indicative of active transmission.

The prevalence of typhoid fever (17.4%) was relatively lower than that of malaria (59.9%). This may be due to the influence of the rainy season, during which water was abundant for domestic use. There was no significant difference between prevalence of typhoid fever and sexes (P = 0.8522) as had been observed by Olopoenia and King (2000) and Rahman *et al*. (2001). However there was significant difference between various age group being highest among older children (Rahman *et al*., 2001).

The highest proportion of *Salmonella* sp. Isolated from the stool culture (100%) of agglutination Widal reaction with 1:320 titre suggest that this value should be considered as significant for the treatment of typhoid enteric fever. However, as the isolation of *Salmonella* sp. in stool is confirmatory diagnosis for typhoid fever, over 50% *Salmonella* isolated in stool of 1:160 titre Widal reaction in this study, is supportive of the bottom

line titre value used by the physicians in this locality for treatment of typhoid fever. In Nigeria, Tanyigna *et al*. (1999) suggested from the findings in Jos that only titre of 1:160 and 1:320 and above for O and H antigen should be considered significant. This study is supportive of the benchmark of 1:160 as significant for the commencement of treatment because a higher titre value would miss out over 50% of patients who have received prompt attention from this infection, considering the fact that intestinal perforations which is a complication of the disease, is a cause of high mortality and morbidity among children in developing countries (Abatanga and Waife-Addai, 1998). Elsewhere in Ghana, Frimpong *et al*. (2000) also considered Widal reaction of ≥1:160 or ≥1:320 as diagnostic for enteric fever in Kumasi.

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