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Prevalence of Malaria Parasitaemia in Umuchieze and Uturu Communities of Abia State, Nigeria

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ABSTRACT

Malaria intensity in rural areas of Nigeria is of public health significance. In this study, the prevalence of malaria parasitaemia in Umuchieze and Uturu rural communities of Abia State, Southeast Nigeria were investigated in order to provide epidemiological data on malaria in the study communities for effective management programme. A total of 620 individuals (310 in each community) were examined for malaria parasites using standard methods. The results showed that a total of 455 (73.39%) among the studied individuals were infected. Infection rates in Umuchieze and Uturu were 72.58 and 74.19%, respectively but the difference was not statistically significant ($p>0.05$). Also, the infection rates recorded for males (73.87%) and females (72.90%) in both communities did not differ statistically ($p>0.05$). Members of the age cohorts 11-20 years recorded the highest rate of infection, 82.61% and 88.24 in Umuchieze and Uturu, respectively. The highest rate of prevalence of malaria parasitaemia was identified among farmers in Umuchieze (85.60%) while in Uturu it was identified among students (81.33%). *Plasmodium falciparum, Plasmodium vivax and Plasmodium malariae* were found among the positive cases in both study areas with *Plasmodium falciparum* being the highest with infection rate of 52.26% in Umuchieze and 53.55% in Uturu. Overall, the infection rate of *Plasmodium* species in both study communities is 72.09, 19.56 and 8.35% for *P. falciparum*, *P. vivax* and *P. malariae*, respectively. The results showed that Umuchieze and Uturu Communities were endemic for malaria.

Key words: Malaria parasitaemia, *Plasmodium* species, infection rate, Umuchieze community, Uturu community

INTRODUCTION

Malaria caused by protozoan parasites of the genus *Plasmodium,* remains the most infectious human parasites that infects and kills higher percentage of people than any other single infectious disease (Sherman, 1998). The four known species of *Plasmodium* genus that cause human malaria are *Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale and Plasmodium malariae* (Abdoon and Alshahrani, 2003; Duchemin *et al.*, 2001) and they contribute to majority of human health problem in malaria endemic regions of the world (Mohan and Ramaswamy, 2007; Oparaocha, 2003). They are spread from one person to another through the bites of

haematophagous anthropophilic female adults of mosquitoes belonging to the insect genus *Anopheles*. These adult female *Anopheles* mosquitoes are, hence said to be carriers or malaria parasites.

Malaria infection is largely distributed throughout warmer regions of the world especially in the tropics, where the vectors of malaria are found in large numbers (Lee *et al*., 2001). Farming activities which takes place mostly during the rainy season period of the year favours the breeding of mosquitoes and this makes the effects of malaria apparently noticeable in rural areas due their proximity to farmlands (Aribodor *et al*., 2003; WHO, 2000). Studies in rural areas of Africa where malaria is endemic revealed that primary school children are most vulnerable to malaria infection (Aribodor *et al*., 2003). In Nigeria, malaria is holoendemic and it is one of the reasons of the high mortality rate in children (Ukpai and Ajoku, 2001; Bruce-Chwatt, 1993).

P. falciparum out of the four *Plasmodium* species that cause human malaria, accounts for most of the infections in Africa and over one third of the infection in the rest of the world while about 70% of infection due to *P. vivax* occurs in Asia (Ukpai and Ajoku, 2001). Malaria is responsible for 700,000 to 2.3 million deaths each year the world over, mainly among children (WHO, 1995). Worldwide, it is estimated that there are about 120 million cases of malaria per year, each lasting between 5-15 days often incapacitating the patients (Coker *et al*., 2001). Apart from causing morbidity to millions of people in endemic communities and actual mortality, the disease also reduces their resistance to infection by other diseases (Oparaocha, 2003). Useful man-hours are lost leading to low productivity, loss of revenue, social and economic depression. There may be absenteeism among school children due to malaria, leading to poor academic performance and low standard of education.

From the above, it is disheartening that more than half the population of Nigeria is entrapped by the worst manifestations of poverty worsened by malaria, malnutrition, low income and high mortality due to malaria (Bruce-Chwatt, 1993). Thus, the poor are caught in vicious circle, they are sick because they are poor; they become poorer because they are sick and sicker because they are poorer. Malaria disease imposes its heaviest socio-economic burden on the rural population that depends on farming for their livelihood (Kachur *et al*., 1998; Bawden *et al*., 1995; PAHO, 1991).

In view of the adverse effects of malaria on the victim, house-hold and treasure, the society and nation, it is important from the medical and socio-economic standpoint to stamp out the disease. It is obvious that the fight against malaria in Nigeria is deteriorating due to some factors which include poor administration, financial inadequacies, inadequate planning and lack of proper vector-control measures (Ukaga *et al*., 2003; Ukpai and Ajoku, 2001).

The purpose of this research was to determine the rates of malaria infection in Umuchieze and Uturu (rural areas), assess the prevalence of malaria parasitaemia with regards to sex, age and occupation of the inhabitants of the areas and identify the *Plasmodium* species prevalent in the areas. This study hopes to enrich the epidemiological data on malaria in Abia State in particular and Nigeria in general for an effective malaria management programme.

MATERIALS AND METHODS

Description of study areas: Umuchieze and Uturu, though located in different Local Government Areas of Abia State are in the same biogeographical region as well as belong to the same climatological regime. The climate is considered tropical (Umuchieze 5°04'N latitude and 7°10'E longitude; Uturu 5°51'N latitude and 7°30'E longitude). April through September and October through November are considered the long and short seasons of rains, respectively, with

precipitation varying from 1,700 mm to over 2,200 mm per year. Mean daily maximum air temperature ranges from 28-35°C while mean daily minimum air temperature ranges from 19-24°C (Igbozurike, 1986).

Umuchieze is a community in Umunneochi Local Government Area, Abia State of Nigeria. The area is rocky and hilly. Extensive stone mining and blasting activities by Quarry Mining Companies created and later abandoned some quarry pits which became filled with water, thereby, resulting in the formation of artificial lakes in the community. The lakes may be potential breeding habitats for malaria vectors.

Uturu is in Isuikwuato Local Government Area of the State. The Abia State University main campus is sited in this community. Ihiku and Atuma streams provide all year-round drinking water to the inhabitants of the community. The streams possess features that favour the breeding places for the vectors. No malaria prevalence studies have been carried out within Umuchieze and Uturu communities.

Data collection: Blood samples and responses to questionnaires were collected from consented individuals in their homes according to WHO/CDC (2003). Blood samples were collected 620 individuals in the two study areas comprising 310 individuals from each community. The study design covered equal number of males and females (i.e., 155 male and 155 female) in each community. Venous blood sample (5 mL) was collected from each resident participant aged above 10 years using a disposable syringe in line with the method described by Fleck and Moody (1998) while thumb blood was collected from children of 0-10 years cohort by finger-prick method using disposable sterile lancets. Blood collected was then used to prepare thin and tick blood smears for observation under the microscope.

Statistical evaluation: Chi-square (χ^2) test was employed to establish any relationship between malaria parasitaemia and sex, age and occupation. Statistical significant differences were indicated by $p<0.05$.

RESULTS

The results of gender-related prevalence of malaria parasitaemia in the study areas are shown in Table 1. The results indicated that 455 (73.39%) out of 620 individuals in the two study areas showed positive blood smear for malaria parasites. The rate of prevalence of malaria parasitaemia in Umuchieze was 72.58% while it was 74.19% in Uturu (Table 1). The level of parasitaemia in different sexes indicated that 72.90% males and 72.26% females were infected in Umuchieze while in Uturu 74.84% males and 73.55% females had malaria infection. Analysis showed that there was significant relationship between sex and malaria parasitemia at the two communities (χ^2, $p<0.05$) (Table 2). For this χ^2_{cal} value is 0.0013 and χ^2_{tab} is 3.84, as $\chi^2_{cal}<\chi^2_{tab}$, H_o is rejected and we conclude that there a significant relationship between sex and malaria parasitemia at the two communities at $p<0.05$.

Table 3 summarized the results of age group related prevalence of malaria parasitaemia in Umuchieze and Uturu. Individuals in the age group 11-20 years had the highest rate of malaria infection in the two study locations: 82.61 and 88.24% infections in Umuchieze and Uturu, respectively. However, 21-30 years age group had the same infection rate as that of age group 11-20 years in Umuchieze community. The elderly (>60 years) in both communities were least infected: 50.00 and 43.75% infection rate in Umuchieze and Uturu, respectively. Analysis

Table 1: Gender-related prevalence of malaria parasitaemia in the study areas

	No. of individuals examined		No. of individuals infected		Percentage infection		
Study areas	M	F	M	F	M	F	M+F
Umuchieze	155	155	113	112	72.90	72.26	72.58
Uturu	155	155	116	114	74.84	73.55	74.19
Sub total	310	310	229	226	73.87	72.90	
Grand total	620		455		73.39		

M: Males, F: Females

Table 2: Chi-square (χ^2) of sex-related prevaleuce of malaria parasitemia in Umuchieze and Uturu

	Sex		
Study area	Male	Female	Pi
Umuchieze	72.90 (73.06)	72.26 (72.10)	145.16
Uturu	74.84 (74.68)	73.55 (73.71)	148.39
Pj	147.74	145.81	293.55

df = 1, Pi: Total observed frequeucy in the rows, Pj: Total observed frequency in the column, Expected frequency is in parenthesis

Table 3: Age-related prevalence of malaria parasitaemia in Umuchieze and Uturu

	Umuchieze			Uturu		
Age cohort (years)	No. of examined	No. of infected	Rate of infection (%)	No. of examined	No. of infected	Rate of infection (%)
0-10	49	34	69.39	50	42	84.00
11-20	46	38	82.61	68	60	88.24
21-30	62	51	82.61	52	37	71.15
31-40	68	52	76.47	50	36	72.00
41-50	44	29	65.91	46	31	67.79
51-60	31	16	51.61	28	17	60.71
>60	10	5	50.00	16	7	43.75
Over all	310	225	72.58	310	230	74.19

(Table 4) showed that there was a significant relationship between age cohort and malaria parasitemia at the two communities. For this χ^2_{cal} value is 3.66 and χ^2_{tab} is 12.59, as $\chi^2_{cal}<\chi^2_{tab}$, H_o is rejected and we conclude that there a significant relationship between age cohort and malaria parasitemia at the two communities at $p<0.05$.

The results of occupation-related prevalence of malaria parasitaemia in Umuchieze and Uturu communities are shown in Table 5. Farmers followed students had the highest rate of malaria parasitaemia (i.e., 85.60% followed by 69.66%) in Umuchieze while in Uturu, students followed by farmers (i.e., 81.33% followed by 78.38%) recorded the highest. Civil servants were the least infected in Umuchieze (43.48%) followed by Entrepreneurs (54.56%) while in Uturu, Entrepreneurs were least infected (43.75%) followed by civil servants (56.00%). Analysis (Table 6) showed that there was a significant relationship between occupation and malaria parasitemia at the two communities. For this χ^2_{cal} value is 4.35 and χ^2_{tab} is 9.49, so $\chi^2_{cal}<\chi^2_{tab}$, H_o is rejected and we conclude that there a significant relationship between occupation and malaria parasitemia at the two communities at $p<0.05$.

The occurrence of *Plasmodium* species in the study communities is shown in Table 7. The results indicated that *Plasmodium falciparum, Plasmodium vivax* and *Plasmodium malariae* were found among the positive cases in both study areas with *Plasmodium falciparum* being the highest

Table 4: Chi-square (χ^2) of age-related prevalence of malaria parasitemia in Umuchieze and Uturu

Study area	Age (years) 1-10	11-20	21-30	31-40	41-50	51-60	>60	Pi
Umuchieze	69.39 (75.98)	82.61 (84.63)	82.61 (76.16)	76.47 (73.54)	65.91 (66.22)	51.61 (55.63)	50.00 (46.44)	478.60
Uturu	84.00 (77.41)	88.24 (86.22)	71.15 (77.60)	72.00 (74.93)	67.79 (67.48)	60.71 (56.69)	43.75 (47.31)	487.64
Pj	153.39	170.85	153.76	148.47	133.70	112.32	93.75	966.24

df = 6, Pi = Total observed frequency in the rows, Pj = Total observed frequency in the column, Expected frequency is in parenthesis

Table 5: Occupation-related prevalence of malaria parasitaemia in Umuchieze and Uturu

	Umuchieze			Uturu		
Occupation	No. of examined	No. of infected	Rate of infection (%)	No. of examined	No. of infected	Rate of infection (%)
Students	89	62	69.66	150	122	81.33
Civil Servants	23	10	43.48	50	28	56.00
Farmers	125	107	85.60	74	58	78.38
Traders	62	40	64.52	20	15	75.00
Entrepreneurs	11	6	54.56	16	7	43.75

Table 6: Chi-square (χ^2) of occupation-related prevalence of malaria parasitemia in Umuchieze and Uturu

Study area	Occupation Students	Civil servants	Farmers	Teachers	Entrepreneurs	Pi
Umuchieze	69.66 (73.57)	43.48 (48.47)	85.60 (79.90)	64.52 (67.98)	54.56 (47.90)	317.82
Uturu	81.33 (77.42)	56.00 (51.01)	78.38 (84.08)	75.00 (71.54)	43.75 (50.41)	334.46
Pj	150.99	99.48	163.98	139.52	98.31	652.28

df = 4, Pi: Total observed frequeucy in the rows, Pj: Total observed frequency in the column, Expected frequency is in parenthesis

Table 7: Occurreuce of *Plasmodium* species in the study communities

	Umuchieze			Uturu				
Plasmodium species	No. of examined	No. of infected	Rate of infection (%)	No. of examined	No. of infected	Rate of infection (%)	Over all species infection	Over all rate of infection
P. falciparum	310	162	52.26	310	166	53.55	328	72.09
P. vivax	310	45	14.52	310	44	14.19	89	19.56
P. malariae	310	18	5.80	310	20	6.45	38	8.35

with infection rate of 52.26% in Umuchieze and 53.55% in Uturu. Overall, the infection rate of *Plasmodium* species in both study communities is 72.09, 19.56 and 8.35% for *P. falciparum*, *P. vivax* and *P. malariae*, respectively.

DISCUSSION

The great loss of lives, loss of useful man-hours of labour, the cost of treatment of patients and the negative impact of the disease make malaria a major social and economic burden (Ukpai and Ajoku, 2001; Alles *et al.*, 1998). The high prevalent rates of malaria in Umuchieze (72.58%) and Uturu (74.19%) show that malaria infection is endemic in these two rural communities (Table 1). These findings agree with the report of Ukpai and Ajoku (2001) that malaria is holoendemic in Nigeria and that it is one of the reasons of high mortality rate in children.

The findings of the present study also conform to the report of WHO (2002) that malaria is endemic in rural areas of Africa. The high prevalence of malaria in both rural areas could be due to the effects of climatic factors such as temperature, humidity and rainfall which regulate the biology of development of both mosquito and parasite (Martin and Lefebvre, 1995), as well as the behavioural attitude of the inhabitants of the areas. Both study areas have climatic factors and environmental conditions which favour breeding of vectors of malaria parasites resulting in the probable abundance of malaria vectors in the areas.

Gender-wise, males seemed to be more infected (73.87%) than females (72.90%) in both study areas taken together (Table 1). This could be due to the fact that the males expose themselves more than the females especially when the weather is hot, by moving about bare-bodied thereby exposing themselves more to malaria vector bites than the females. These results compared with those reported by Ukpai and Ajoku (2001) and Kachur *et al.* (1998).

Subjects aged 11-20 years had the highest rate of infection in both study communities: 82.61% in Umuchieze and 88.24% in Uturu. In Umuchieze, 21-30 years age cohort had the same rate of infection with 11-20 years age bracket. The elderly subjects in both rural areas had the least infection rates of 50.00% and 43.75% in Umuchieze and Uturu, respectively (Table 3). Kachur *et al.* (1998) reported higher prevalent rates in individuals of 15 years old and above. Similar results were also reported for Azia Community by Aribodor *et al.* (2003). The high infection rates in age groups 10-20 and 21-30 years could be due to inadequate protection against malaria vector bites or insufficient knowledge about malaria transmission or both. Moreover, these age groups consist of youths whose behaviour and activities predispose them to incessant contacts with vectors of malaria.

In occupation related prevalence of malaria parasitaemia, the highest rate of infection was observed among the farmers (85.60%) followed by the students (69.66%) in Umuchieze while in Uturu students had the highest rate of infection (81.33%) followed by the farmers (78.38%). Entrepreneurs in both communities recorded the least rate (Umuchieze 54.56%; Uturu 43.75%) of infection (Table 5). Similar results for occupation related malaria prevalence has been reported in similar studies Ukpai and Ajoku (2001) and Martin and Lefebvre (1995). The high rates of infection among farmers in the two areas could be attributed to the nature of their job which exposes them to the bites of exophagous malaria vectors while in their farms in addition to their contacts with endophagous nocturnal vector bites while asleep after farm work. The farmers are usually fatigued at nights resulting in deep sleep at night the condition of which encourages the uninterrupted bloodsucking tendency of the nocturnal and endophagous vectors of malaria.

Daily activities of youths could well be equated to those of the farmers. Thus, the youths are equally exposed to the incessant bites of diurnal exophagous and endophagous as well as nocturnal exophagous and endophagous malaria vectors (Ukpai and Ajoku, 2001; Bruce-Chwatt, 1993). These might be the reasons for the high rates of malaria infection recorded by students, who are the youths in Uturu and Umuchieze.

The prevalence of *Plasmodium* parasites show that *Plasmodium falciparum* had the highest rates of infection in Umuchieze (52.26%) and Uturu (53.55%) (Table 7). This finding agrees with Ukpai and Ajoku's findings (Ukpai and Ajoku, 2001) that the predominant *Plasmodium* species in Owerri and Okigwe was *P. falciparum*. According to Beier *et al.* (1999), *Plasmodium falciparum* malaria is almost entirely confined to the tropics and sub-tropics. It is therefore, not surprising that *Plasmodium falciparum* featured highly in the study areas since they are typical tropical rural areas. The rates of *Plasmodium falciparum* infection in the two communities did not differ

significantly. This could be attributed to the fact that Umuchieze and Uturu are located in the same biogeographical region as well as belong to the same climatological regime.

The findings of this study indicate that the there is a cause for public health concern in the rural areas, especially the two study areas and rural communities in Abia State in general. The findings also provided base-line information for evidence-based planning and implementation of malaria control activities in the state by governments, their agencies and individuals.

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