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Research Article

Malaria Prevalence and Mosquito Vector Abundance in Uli Town, Ihiala Local Government Area, Anambra State, Nigeria

Onyido A.E[1], Obinatu S. C[1], Umeanaeto P.U[1], Obiukwu M.O[1] and Egbuche M.C[1] [1]
Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University, P.M.B. 5025, Awka, Anambra State, Nigeria

ABSTRACT: Malaria prevalence and mosquito vector abundance in Uli town in Ihiala Local Area of Anambra state, Nigeria, was studied between April and July 2010. Oral interviews were used to get personal data of participants. Blood film preparations and microscopy were used to detect malaria parasites in the blood. 178 participants made up of 111(62.45%) males and 67(37.6%) females from the ten villages of the town were involved in the study. Participants were aged between 0 – 70 years and were subdivided into 7 age groups of ten years intervals each, occupational and educational groups. Of the 178 participants examined, 126 (70.8%) were positive with malaria parasites. Species detected include *P. falciparum* (80.2%), *P. malariae* (13.6%), *P. ovale* (4.4%) and mixed infection of *P. falciparum* and *P. malariae* (1.6%). The age group 31-40 years had the highest malaria prevalence 42(85.71%) while 0-10 had the least 6(42.86%). The malaria prevalence in relation to age was significant (15.100, df=5; p<0.05). The males 82(73.9%) were slightly more affected than the females 45(65.7%), but not statistically significant (0.683, df-5; P>0.05). Malaria prevalence was significantly higher among those without formal education 7(77.7%) and least among those with tertiary education 5(35.7%; P<0.05). Malaria prevalence among different occupational groups showed no significant difference though farmers were slightly more infected than others (p>0.05). Of 484 mosquito larvae collected, the *Anopheles gambiae* larvae were 109(22.5%). Pyrethrum Knockdown Collection (PKC) of indoor biting and resting adult mosquitoes gave 272 mosquitoes in which *A. gambiae* yielded 170(62.5%). Correlation analysis showed that vector abundance was strongly and positively related to malaria in Uli town (r = 0.1321484).

Keywords: *Malaria, Vector Abundance, Rainforest community*.

INTRODUCTION

Malaria is a serious public health disease worldwide affecting about 350 to 500 million people each year with more than one million deaths, mostly in Sub-Saharan Africa (WHO, 1995). There are four species of human *Plasmodium* namely; *P. falciparum*, *P. vivax*, *P. ovale and P. malariae* (Attah, 2000; Colleen, 2002; Paniker, 2003*)*. *P. falciparum* and *P. vivax* are the most pathogenic forms (WHO, 1995).

Malaria presents one of the most pressing healthcare problems in Africa (Howard, 1994; Uko *et al*, 1998). It is holoendemic in Nigeria with *P. falciparum* as the dominant species (Uko *et al*, 2002). *P. falciparum* is responsible for about 90% of the infections *while P. malariae* and *P. ovale* are responsible for about 8% and 2% respectively (Coker *et al*, 2001). Infection with *P. vivax* is rare in indigenous West African populace because of absence of Duffy blood group antigens on the erythrocytes surface (Coker *et al*, 2001; Horuk, 2001).

Pathophysiological processes in malaria result from massive destruction of the erythrocytes, liberation by the parasites an erythrocyte material (haemozoin) into general blood circulation during schizogony and then the host's immune responses to these events. The rupturing schizonts release substances which stimulate macrophages and monocytes to secrete endogenous

*Address for correspondence:
E-mail: mumamaka@yahoo.com

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pyrogens (substances which cause fever by acting on hypothalamus). *Plasmodium* infected red blood cells also remain in the blood vessel thus interfering with microcirculatory flow and host's tissues metabolism (White and Ho, 2004).

Malaria is transmitted solely through the bites of infected female *Anopheles* mosquitoes. The mosquito genus, *Anopheles*, includes over 400 species which are widely distributed. The most important malaria transmitting species in Nigeria and other parts of Africa include *Anopheles gambiae*, *A. funestus*, *A. arabiensis* and *A. mellas* (FOS, 1993, Alaribe *et al*, 2002). Olaniran (1978) observed that *Anopheles* species are very adaptable to various breeding sites in both urban and rural areas. The species diversity and seasonal abundance has been observed to result in stability and intensity of malaria (Githecko *et al*, 1996). This study is aimed at investigating the prevalence of malaria and mosquito vector abundance in Uli, a rainforest community, in Ihiala Local Government Area of Anambra State so as to determine the extent of relationship between the two.

MATERIALS AND METHODS:

Study Area

The study area was Uli town in Ihiala Local Government Area of Anambra State, Nigeria. Uli has a population density of about 40, 000 (NPC, 1991). It is located between Longitude $6^{o}70^{1}$ and $6^{o}65^{1}$E and Latitude $6^{o}20^{1}$ and $6^{o}30^{1}$N of the Equator (Microsoft Encarta 2009). The average daily temperature of the area during dry season ranges from 22^{o}C and 35^{o}C running from November to March. In the rainy season, the temperature ranges from 18^{o}C to 29^{o}C running from March to October. The annual relative humidity is 75% reaching 85% in the rainy season. The vegetation of the town is of rainforest type with annual rainfall ranging from 2000mm – 3000mm. The majority of the inhabitants of the town are farmers mainly of subsistent type with a few civil servants, traders, students and other professionals.

The town is made up of 10 villages viz: Amamputu, Ndiegungwu, Obodo-okolie, Ubahudara, Aluora, Ugwurugwuala, Umuaku, Eziama, Umuchima and Ndiatughobi. The town has considerably a good number of small streams found bordering different villages. Each community has at least two streams which are located near human habitations, where laundry activities, breadfruit washing, cassava and bitter-leaf squeezing are regularly carried out by women and children while some children swim around at their leisure. In Amamputu community, there are four major streams namely; Mmiri-Agbo, Mmiri-Abonze, Mmiri-Enyinja and Mmiri-Oba. Others (Mmiri-Oru, Mmiri-Ohia, Mmiri-Ogonzu, Mmiri-Ayo and Mmiri-Ihuaho) are the major streams in Ndiegungwu and Umuoma-Uli villages; while Mmiri-Oji and Atammiri streams are found in Aluora and Ugwurugwuala respectively. These streams are major sources of domestic and drinking water for the villagers, as well as their fishing needs. The freshwater swamps and pools associated with the streams provide favorable breeding sites for mosquito vectors. In addition, many villages do not have regular supply of pipe-borne water and as such, there are water storage containers in and around houses especially during dry seasons of the year.

Community Mobilization

Prior to the study, announcements were made publicly in various churches in the town. Also, letter of intent and introduction obtained from the Head of Department of Parasitology and Entomology, Nnamdi Azikiwe University Awka, Anambra state, was taken to the Igwe of the town and members of the council of various kindreds in the town. This facilitated both access and co-operation of the people. With their permission, public sensitization in the various communities was conducted.

Selection of Paticipants

A total of 178 people were randomly selected from the ten communities in the town using stratified random sampling. Majority of the participants in the study were healthy individuals who did not show any common signs of malaria. Their biodata such as names, ages, sex and occupations were collected through oral interview and recorded in a field note book. Participants were aged between 0-70 years and were subdivided into 7 age groups of ten years intervals each, occupational and educational groups.

Blood collection and staining

Blood samples were collected from apparently healthy individuals by venepuncture based on individual's consent. The blood was collected into potassium (k) EDTA tubes to prevent coagulation. Thick and thin films made from each sample. The blood films were stained with Giemsa stain (10% dilution) as described by Cheesbrough 2006 and were examined microscopically under oil immersion (100x) objectives.

Collection of Mosquito Larvae

Larval stages of mosquitoes were sampled from the following breeding environments;

1. Discarded or used tyres
2. Ground pools such as rainwater collections on the roads, pools of water around public taps, potholes, gutters, and ground water around houses.
3. Domestic reservoirs such as earthen pots, water drums, plastic buckets, cans, and tins of assorted types.

Ladles were used for collection of larvae in ground pools, earthen pots and discarded tyres. All the collections were sieved to reduce debris. All collected larvae were stored with little water in large labeled specimen bottles (jam jars) covered with mosquito nettings to provide ventilation. The larvae were sent to the National Arbovirus and Vectors Research Centre Laboratory Enugu for proper identification. All the larvae were reared to adults before identification.

Collection of indoor-biting and resting adult mosquitoes

Five houses were randomly selected from each community for entomological studies of indoor-biting and resting mosquitoes. All indoor-biting and resting adults were sampled using Pyrethrum Knockdown Collection (PKC) method between 6.00 and 10.00 hours in the morning (6 am – 10 am local time). Food items were covered properly and moveable furnitures taken care of before spraying. Large white sheets of cloth were spread wall to wall to cover the floors of the room while all doors and windows were shut. All cracks and openings in walls were stocked with rag papers to prevent mosquitoes from escaping. In houses without ceiling, pyrethrum based aerosol formulated insecticide (Baygon) was sprayed from the outside while the spray was only in the inside for houses with ceiling. After about 20 minutes, the spread cloths were carefully folded starting from the corners. Knocked down mosquitoes were collected with forceps into a damp Petri dish. The Petri dishes were lined at the base with filter paper placed over soaked cotton wool. The collections were also sent to the National Arbovirus and Vectors Research Centre Laboratory Enugu, for identification.

The mosquitoes were identified using the gross morphology of the species, external morphology of the head, mouthparts, antennae, proboscis, patches of pale and black scales on the wings and legs and the terminal abdominal segments (Gillet, 1972).

Data Analysis

Data for malaria prevalence were analysed statistically using the student Chi-square test. Correlation analysis (r = Spxy/Ssx.ssy) was used to test for the relationship between malaria prevalence and malaria vector densities.

RESULTS

Out of 178 people examined for malaria parasite in Uli Community, 126 were positive thus, giving a total prevalence of 70.8%. Aluora village had the highest prevalence 12(85.7%) while Obodo-okolie has the least 5(50.0%), the prevalence of malaria was not significant among different villages studied (15.096 df=5, p>0.05) [table 1]. Males 82(73.9%) were mostly infected than the females 45(65.7%) [Table 2], although the malaria prevalence according to sexes was not significant (0.683 df=5, p>0.05).

Table 1:
Malaria Prevalence in different villages OF Uli town

Villages	Number of people examined	Number positive	Prevalence (%)
Amamputu	16	11	68.6
Ndiegungwu	35	25	74.4
Obodo-okolie	10	5	50.0
Ubahudara	12	9	75.0
Aluora	14	12	85.7
Ugwurugwuala	18	15	83.3
Umuaku	14	10	71.4
Eziama	17	12	70.6
Umuchima	16	11	68.8
Ndiatughobi	26	16	61.5
Total	178	126 (70.8%)	126 (70.8%)

Observed χ^2 value = 15.096, df= 5; and table value = 16.919; p >0.05.

Table 2:
Prevalence of Malaria parasitaemia by sex

Sex	Number examined	Number positive	Prevalence (%)
Male	111	82	73.9
Female	67	45	65.7
Total	178	126	70.8

Observed χ^2 value = 0.683, df= 5; and table value = 3.841; p >0.05.

The *Plasmodium* species isolated were *P. falciparum* (80.2%), *P. malariae* (13.6%) and *P. ovale* (4.4%) and mixed infection of *P. falciparum* and *P. malariae* (1.6%) [Figure1]. The age group 31–40 years had the highest malaria prevalence 42(85.71%) while and the age group 0–10 years has the least 6(42.86%) and the results were significant (15.100 df=5, p<0.05) [Table 3].

Table 3:
Prevalence of Malaria parasitaemia by age

Age groups	Total number examined	Number positive	Prevalence (%)
0 – 10	14	6	42.86
11 – 20	38	28	73.68
21 – 30	26	20	76.92
31 – 40	49	42	85.71
41 – 50	31	17	54.84
51 – 60	8	5	62.50
61 – 70	12	8	66.67
Total	178	126	70.8

Observed χ^2 value = 15.100, df= 5; and table value = 12.592; p <0.05.

Considering the educational status of the patients in relation to malaria prevalence (Figure 2), showed significant difference (p<0.05) between the tertiary education group 5(35.7%) and those with no formal education at all 7(77.7%). Further stratification of malaria prevalence with respect to occupational status was not statistically significant (p>0.05) [Figure 3], though the farmers 25(92.6%) were infected most while the traders 16(57.1%) have the least infection.

From the entomological studies, a total of 484 mosquito larvae made up of five species were collected (table 4). *Anopheles gambiae*, which is malaria vector, was among the larval species collected yielding 109(22.5%). Pyrethrum knockdown collection of indoor-biting and resting adult mosquitoes yielded 272 mosquitoes made up of three species (Table 5). *Anopheles gambiae* has the largest collection 170(62.5%). Correlation analysis indicated that mosquito vector population was positively correlated with malaria prevalence in Uli town (r=0.1321484).

Table 4:
Mosquito species collected as larvae from various breeding grounds in Uli town

Mosquito species	Breeding grounds							
	Ground pools with dirty water	Domestic containers	Polluted water in gutters	Clean water pools in gutters	Unpolluted water in roadside potholes	Polluted water in roadside potholes	Used tyres	Total (%)
Ampheles gambiae	0	18	0	52	39	0	0	109 (22.5)
Culex guinquefasciatus	5	35	119	0	2	22	4	187 (38.6)
Culex tigrepes	3	0	4	0	0	17	5	19 (3.9)
Aedes albopictus	5	11	15	5	0	9	113	158 (32.6)
Toxorhynchites	0	8	0	0	0	0	3	11 (2.3)
Total	13	72	138	57	41	48	125	484
% abundance	2.7	14.9	28.5	11.8	8.5	9.9	25.8	100

Table 5
Adult Mosquitoes collected with Pyrethrum Knockdown Method (PKC) from selected houses at Uli, Anambra State, Nigeria.

Mosquito species collected	Number of Mosquitoes collected from various villages										Total (%)
	A	B	C	D	E	F	G	H	I	J	
Anopheles gambiae	21	16	12	15	25	30	6	8	20	17	170 (62.5)
Culex guinquefasciatus	0	5	10	2	15	11	0	3	12	0	58 (21.3)
Aedes aegypti	7	5	0	1	1	16	10	2	1	1	44 (16.2)
Total	28	26	22	18	41	57	16	13	33	18	272 (100)
% abundance	10.3	9.6	8.1	6.6	15.1	21.0	5.9	4.8	12.0	6.6	100

Keys: *A=Amam putu; B = Ndiegu ngwu; C = Obodo-Okolie; E =Ubahu'dara; F =Aluora; G = Ugwuru Gwuala; H = Umuaku Eziama I = Umuchima; J = Ndiatughobi*
Correlation coefficient r=0.1321484; p<0.05

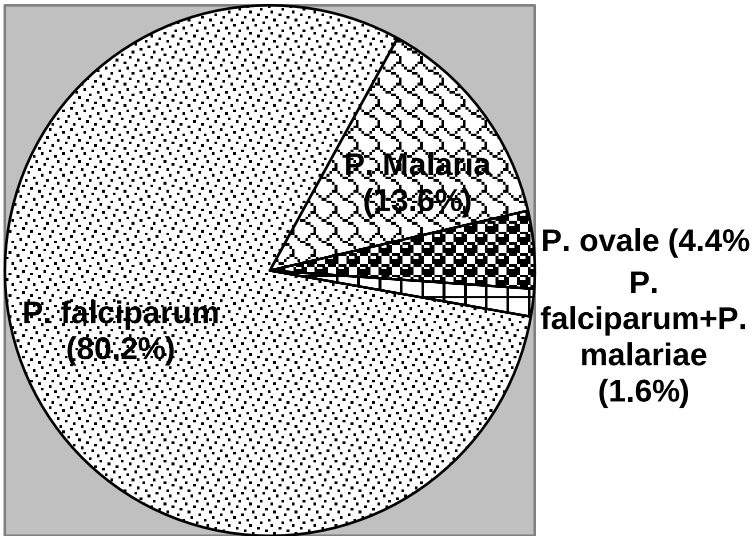

Figure 1: Pictorial Representation of the percentage of different plasmodia of man as found in the study

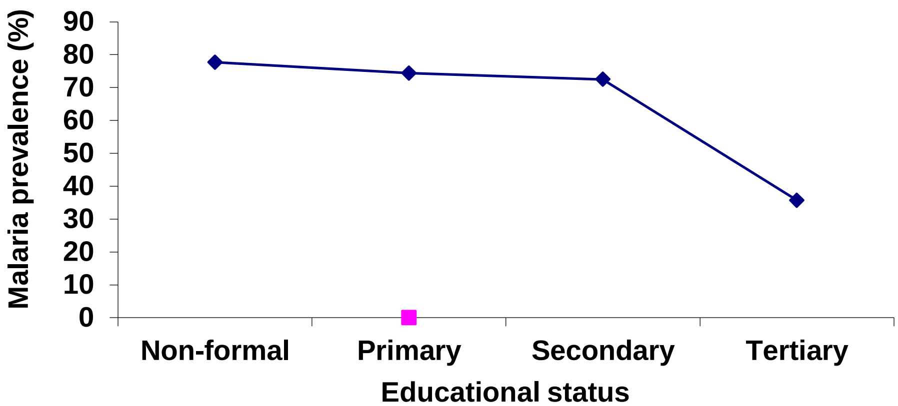

Figure 2: Line graph showing malaria prevalence with respect to educational status of the participants

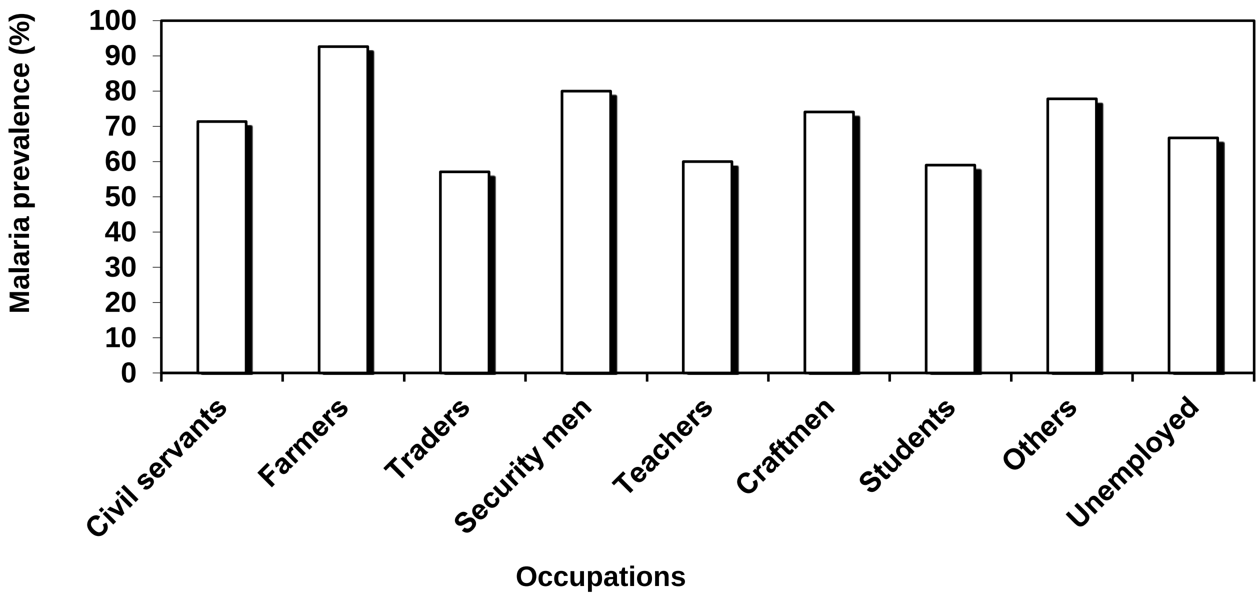

Figure 3: Bar Chart showing malaria prevalence with respect to occupation of the participants.
Note: Others include welders, mechanics and bicycle repairers, clergy, fishermen, shopkeepers, apprentices, mason, carpenter, plumbers and blacksmiths.

DISCUSSION

The high rate of malaria prevalence in the blood samples examined was quite worrisome. This is a reflection of the high rate of asymptomatic malaria parasitaemia in endemic malaria regions. The malaria prevalence (70.8%) was higher than the findings of Eneanya (1998), who reported malaria prevalence of 59.8% in Udi community in Enugu state, south-eastern Nigeria and also that of Onyido *et al* (2010) who reported malaria prevalence of 62.0% in Umudioka community in Anambra state of Nigeria. Mbanugo and Ejims (2000) also observed a malaria prevalence of 58.3% among school children in Awka. It is far more higher than the prevalence of 6% recorded by Ahmed *et al* (2001) among donor population in Maiduguri, north-eastern Nigeria. This wide range of difference may be attributed to difference in climatic factors and behavioral patterns of people in the area which promote mosquito breeding and susceptibility of the people to vector bites. Uli which is located in the rainforest belt of south-eastern Nigeria has higher seasonal rainfall and more surface water which support vector life. In contrast however, Maiduguri is in the Sahel zone of the north-eastern Nigeria which is relatively drier with lesser rainfall.

Malaria prevalence was highest in Aluora village and lower in Obodo-okorie, though the results were not significant. The streams in Aluora and Ugwurugwuala villages are major sources of domestic and drinking water for the villagers, as well as their fishing needs. This may be part of the reasons for higher malaria prevalence found in Aluora village because of their exposure to the bites of mosquitoes during the period the streams are in use.

Plasmodium falciparum, P. malariae and *P. ovale* were recoreded in the study but *P. falciparum* outnumbered other species. According to Markell and Voge (1992), falciparum malaria is almost entirely confined to the tropics and subtropics and is therefore not surprising that *P. falciparum* recorded the highest prevalence rate. In Tanzania, malaria prevalence studies conducted in urban areas of Dodoma and Iringa by Mboera *et al* (2006) indicated that *P. falciparum* was the predominant malaria parasite (Iringa= 100%, Dodoma= 97.8%). Also Umeanaeto *et al*, (2006) recorded predominance of *P. falciparum* in the prevalence and intensity of malaria in blood donors in Nnewi, Anambra State, Nigeria. *P. vivax* was not encountered at all. This was attributed to lack of Duffy antigens necessary for penetration by the species on the erythrocyte surface in the indigenous West Africa.

Malaria prevalence among the sexes was not statistically significant (P>0.05), but malaria parasitaemia was slightly higher among the males (73.0%) than the females (65.7%) (table 3). This agrees with the result obtained by Mendel and White (1994); Pelletier *et al* (1999); Afolabi *et al* (2001); Malcom (2001); and Ukpai and Ajoku (2001). Studies have shown that females have better immunity to malaria and varieties of other parasitic diseases and this was attributed to hormonal and genetic factors (Mendel and White, 1994). Portilo and Sullivan (1997) suggested that genetic factors could play a role by endowing females with immuno-regulatory potentials to cope better with some disease infections. This may equally be attributed to the fact that males expose themselves to the bites of mosquitoes and other vectors more than females, especially when the weather is hot and during farm work. Exception is found during pregnancy and reproductive ages, when females are more vulnerable to malaria attacks due to immune suppression (Aribodor *et al*, 2003).

Malaria prevalence was statistically significant in the various age groups (P<0.05). The age bracket, 31 – 40 years had the highest prevalence while 0 – 10 years had the least prevalence. This may be attributed to greater exposure to mosquito bites due to the nature of their works. The reason for the least prevalence found among the age bracket 0 – 10 years may be due to parental care and protection. This agrees with the work of Uneke *et al*, (2005), who recorded higher prevalence among the older age groups in a similar studies in Jos, Nigeria. During hot weathers, adults are mostly seen sleeping outdoors, sometimes for the whole night exposing themselves to the risk of mosquito bites. Children sleep indoors, properly covered and sometimes under bed nets. Some parents also give their young children anti-malaria drugs with multivitamin supplements as a prophylaxis especially during rainy seasons when rates of vector bites and malaria transmission are high.

Prevalence of malaria parasitaemia was not statistically significant (P>0.05) among different occupational groups, though farmers have the highest prevalence but people in different occupational groups were equally exposed to malaria attack. The effects of malaria are particularly noticeable in the rural settings where agricultural activities are greatest (WHO, 2000), and Uli community is particularly an agrarian community. Ahmed *et al*, (2001) noted that poor farmers from low socio-economic status, with inadequate housing facilities and financial constraints are unable to engage in malaria preventive and control measures. They are also unable to purchase effective anti-malaria drugs.

Further stratification of the prevalence according to educational status gave a significant result ($p<0.05$). The high prevalence among those with non-formal education could be attributed to ignorance and poverty. Ejezie (1983) noted that in addition to abundant mosquito breeding sites in the villages, ignorance, poverty, unsanitary conditions, poor behavioral attitudes and inadequately planned socio-economic projects tend to increase malaria transmission in the rural areas. Education improves general awareness and protection against diseases including malaria (Brieger *et al*, 1997). Education invariably affects people's perceptions about causes of certain diseases of which malaria is not an exception. Lack of knowledge about the consequences of undue exposure to mosquito bites will account for high prevalence rate of malaria infection. Education improves general awareness and could be that those who have tertiary education had better understanding on how to protect themselves against mosquito bites and malaria transmission. Ejezie (1983) obtained high malaria prevalence among those primary and non-formal education and related it to lack of knowledge about malaria prevention and control.

The high population density of *A. gambiae* (62.5%) collected in Uli town synchronized with high malaria prevalence in the area. This is an indicator of the availability of good breeding sites for *Anopheles* mosquitoes in the area, which may be provided by the freshwater swamps, and water pools in farmlands close to human habitations. *Anopheles gambiae*, the predominant species, can breed in undisturbed pools resulting from overflow of river but never in polluted or alkaline water (Aniedu, 1992).

The result of the study showed that *Anopheles gambiae* breed in all the villages thus every person in the town is at risk of malaria attack. Attributes of rate of exposure of the study population to vector bites due to nature of their work and standard of living form a factor in the transmission pattern of the disease. Due to lack of regular supply of pipe-borne water, people resort to storing water fetched from their local streams in earthen pot and containers in and around houses. These provide clear standing water that serve as favourable breeding sites for the malaria vector - female *Anopheles* mosquitoes. Mass education of the people on malaria infection, prevention, and control through environmental management will go a long way in helping to alleviate malaria infection in this and other communities.

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