Vector abundance and Prevalence of Malaria Parasites among hostel Residential Students of Nnamdi Azikiwe University Awka, Southeastern Nigeria.

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Abstract: This study determined the abundance of mosquitoes in the environment and hostels of Nnamdi Azikiwe University, Awka, Nigeria. It also investigated the prevalence of malaria parasites among students residing in the hostels. Mosquito larvae were collected from the hostel surroundings while adult mosquitoes were collected from hostel A, B, D and postgraduate blocks respectively using standard technique. A total of 149 students were examined for malaria parasite. The result of the study showed that 720 mosquito larvae and 201 adult mosquitoes were respectively obtained from the hostel environments. Anopheles mosquitoes constituted 18.19% of the total mosquito collected. Malaria parasites were detected in the blood of 58 (38.9%) out of the 149 students studied. The prevalence rate was highest among students residing in block D (43.59%) while those of postgraduate block (12.11%) had the least. 3(5.58%) students had high intensity infection, 16 (27.58%) medium intensity and 39(67.24%) had low level infection. The male students (43.33%) yielded more malaria parasites than their female counterparts. The result suggests that hostel residential students of the target institution are exposed to malaria infection due to the terrain and environmental conditions around the hostels. The need to maintain good sanitary conditions in school hostels and its surroundings is hereby emphasized.
[Onyido A.E, Ikpo A.U, Obiukwu M.O, Amadi, E.S. **Vector abundance and Prevalence of Malaria Parasites among hostel Residential Students of Nnamdi Azikiwe University Awka, Southeastern Nigeria.** *Nat Sci* 2012;10 (11):150-155]. (ISSN: 1545-0740). http://www.sciencepub.net/nature. 22

Keywords: Mosquito larvae, Malaria parasite, Students hostel

1. Introduction

Malaria is a serious public health problem in most countries of the tropics. It is a major cause of mortality and morbidity. Between 300 and 500 million people suffer acute cases of malaria in 100 developing countries each year, and the majority of the victims are children (UNICEF, 2000). In Nigeria the actual incidence and mortality rates are unknown due to incomplete reporting. The available data indicates that malaria is the most common cause of out patient visits. It ranks among the five most common causes of death for all ages and represents 8-12% of childhood deaths under the age of five years (FMOH, 1990). UNICEF (2000) observed that in affected areas children suffer an average of six episodes of malaria each year, making malaria the most common cause of absenteeism. During the first and second pregnancies, malaria may result in low birth weight, infants and may be associated with increased rate of abortion and stillbirths (FMOH, 1990). It also contributes to high rate of anaemia, and maternal mortality (UNICEF, 2000). Malaria also causes substantial social costs due to the school absenteeism and reduced economic productivity, hence a worker suffering a bout of malaria will lose 10 working days on the average. The disease costs countries in Africa more than 1 percent of their gross domestic product (GDP) and about 10 percent of their expenditure on health (UNICEF, 2000).

Malaria parasites (Plasmodium species) are transmitted to humans through the bites of infected female anopheles mosquitoes. In Nigeria and West African subregion, the major vectors are *Anopheles gambiae* sensu stricto (ss), *A arabiensis, A. funestus* and *A. melas*. In the savanna regions, the most dominant species is *A. arabiensis,* while *A. gambiae* is highly dense in the forest areas. *Anopheles funestus* has an uneven distribution while *A. melas,* a salt water breeding form, is essentially a coastal species. These mosquitoes thrive in warm humid environments including rice paddies.

The permanent site of Nnamdi Azikiwe is a vast low-lying agricultural land hitherto uninhabited by people. It was used primarily for cultivation of rice and other water-loving crops because the land is waterlogged for most periods of the year. The students started occupying the hostels in 2005 and often complained of malaria attacks. No work has been done to relate the students complaints with the environment. This study seeks to determine the vector abundance and malaria prevalence among these students. Specifically, vector species collection

in and around the hostels and identification were undertaken while malaria prevalence was determined by examination of blood films from the students residing in the hostels.

2. Materials and Methods

Study Area:

The study area is Awka, the capital of Anambra State of Nigeria. Awka has geographical co-ordinates of approximately 6^0, 14 and 6^0, 18 North latitude and 7^0, 5" and 7^0, 09" East longitude.

It is located in the tropical rainforest zone and has marked differences in the ecological seasons, the dry and wet seasons. Usually there are about eight months of wet season and four months of dry season. It has a relative humidity of about 70% reaching 80% during rainy season and an annual rainfall of about 2000mm. The temperature of the area during dry period ranges from 36.5^0C maximum to 26^0C minimum stretching from November-March. In rainy season, the temperature ranges from 30^0C maximum and 22.1^0C minimum, stretching from March – October. The people are ethnically Igbos. About 70% of the inhabitants are traders, 25% are civil servants and 5% farmers.

The study site Nnamdi Azikiwe permanent site is surrounded by farmland and stagnant water. In addition to these, empty cans and abandoned tyres are also, found around the campus. Septic tanks are found in the hostels. There are also construction sites around the hostel. All these provide suitable breeding ground for mosquitoes. Stagnant waters and refuse dumps are excellent sites for the breeding of diverse disease vectors (Onyido et al., 2011a)

Collection of Vectors

Mosquito larvae were collected from construction sites, stagnant water pools, tyres, septic tanks and littered containers around the students hostels in the university permanent site. All the mosquito larvae were collected into a plastic bowl with the aid of a ladle. The collection were filtered or sieved through a cloth filter to remove debris and excess water. The larvae were washed into another container with tap water and later taken to the National Arbovirus laboratory Enugu for identification. The larvae were reared to adult and the various species present were identified. The larvae of the genus *Anopheles* were identified at the collection sites by the following characteristics, lying parallel on the surface of water, fast movement and absence of siphon.

Adult mosquitoes collection were carried out in the university hostels comprising four buildings, two female hostels (block A and B), a male hostel (block D) and a post graduate hostel. Rooms were selected randomly from each hostel and sampled. The selection was based on the student's co-operation.

Aerosol-based pyrethroid (Raid) was used as described by WHO (1986) to sample indoor biting and resisting adult mosquitoes. Four white sheets, 2 x 2m each, were spread on the floor to ensure that all the surfaces were covered. Movable furniture items and household properties were taken out of the room. Food and drinking water were well covered or taken out of the rooms where possible and the occupants waited outside the room. The windows and doors were closed before spraying the room. The spraying was done by one person since the rooms were not very big and after 20 minutes, the doors were opened, the sheets were folded from the sides and insects were collected with the aid of forceps by holding then either on the wings, antenna, palps or legs but never on the abdomen because the organism could be destroyed. These were then put inside a petri-dish with wet cotton wool covered with fitter paper to prevent them from drying and taken to the laboratory for identification and processing. Mosquitoes of the genus *Anopheles* were identified using the following features, Palps as long as the proboscis, Spotted wings and Scutellum not lobed but rounded.

Collection of Blood Samples and Film Preparation

After the students biodata such as age and sex was recorded, blood samples were collected and prepared according to Cheesbrough (1998). Blood samples were collected from student volunteers with a sterile lancet puncture. The ball of the third finger of the left hand was used. Cotton wool soaked in alcohol was used to clean the finger using firm strokes to remove dirt and grease from the ball of the finger. With clean cotton, the selected finger was dried using firm strokes to stimulate blood circulation. The finger, slightly raised upward, was punctured with disposable sterile lancet. With application of gentle pressure to the finger, the first drop of blood was expressed. This was wiped off with cotton wool, making sure no trace of cotton wool was left on the finger. With gentle pressure to the finger, three drops of blood were expressed and collected at the middle of the slide for the preparation of thick film. A drop of blood was also collected on another slide for the preparation of thin film. The remaining blood was wiped from the finger with cotton wool. For the preparation of thick films, the edge of another slide (the spreader) was used to spread the blood evenly on the microscopic slide and in a circular motion to about 3 – 6 movements. For the thin film, one out the spreader slide was placed flat at an angle of about 45^0C to the single drop of blood, the block was allowed to spread evenly along

the ridge of spreader slide and quickly but gently pulled forward to make thin films on the slide. The thick and thin films were allowed to air-dry in a flat, level position protected from flies, dust and extreme heat. The slides were subsequently taken to the Parasitology Laboratory of Nnamdi Azikiwe University, for microscopic examination.

Staining and Microscopy

The stock Giemsa stain was diluted to 10% by addition of the buffered water (45ml water + 5ml Giemsa stain). This was used to stain the slides. Slides were washed after 10 minutes using clean water. The back of each slide was wiped clean and then allowed to air-dry. Blood films were then examined for malaria parasites under the microscope using 100x oil immersion objective lens. The positive samples were seen and identified by the deep-red chromatin and pale purplish blue cytoplasm, brown or black pigments except for the ring forms which lack pigment.

3. Results

A total of 149 students were selected from four blocks of the students' hostels. Malaria parasites were detected in the blood of 58 students (38.93%) studied. All of them were infected with *Plasmodium falciparum* (tables 1 – 3).

Table 1: Prevalence of Malaria among Students in the University Hostels

Hostel Blocks	Number Examined	Number Infected (%)
Blocks A	59	22(37.29%)
Blocks B	32	11(34.38%)
Blocks D	39	17(43.59%)
P.G Hostel	19	8(12.11%)
Total	**149**	**58(38.93%)**

The students from Block D recorded the highest malaria prevalence of 43.59% followed by block A. (37.29%), Block B recorded malaria prevalence of (34.38%) while the least malaria prevalence rate was recorded in students from the post graduate Block (12.11%). Here the difference in prevalence of malaria in the various hostel blocks were not statistically significant at 5% level of probability ($x^2 = 0.742 < 7.815$).

Table 2: Prevalence of Malaria Infection in different Sexes

Sex	Number Examiner	Number Infected (%)
Male	90	39(43.33%)
Female	59	19(32.20%)
Total	**149**	**58(38.93%)**

Table 2 shows that out of the 149 students (90 males and 59 females) studied, more males 39 (43.33%) than the females 19 (32.20%) had malaria infection. The difference in malaria prevalence among the males and the females is not statistically significant at 5% level of probability ($x^2=1.86 < 3.841$).

Table 3: The Intensity of Infection with Malaria parasites

Intensity infection			Number Infected
(+%)	(++%)	(+++%)	58
39(67.24)	16(27.59)	3(5.17)	

Legend

\+ = Low intensity
++ = Medium intensity
+++ = High intensity

Among the 58 malaria infected students, 39 students (67.24%) showed low intensity infection, 16(27.59%) had medium intensity infection while 3(5.17%) had very high intensity infection.

The mosquito abundance and the species composition were studied around the hostels to determine the source of infection among the students. The results are presented in tables 4 – 6.

Table 4: Mosquito Larvae collected around the Hostels

Site of Collection	Species Collected	Number Collected	Type of Water
Gutter	*Aedes Anopheles*	111 71	Clear water
Stagnant water	*Culex Anopheles*	57 29	Muddy water
Plastic containers	*Aedes* *Culex*	61 101	Clear water
Septic tanks	*Aedes* *Culex*	65 83	Water containing decayed vegetable matter
Concrete mixer tank	*Anopheles*	30	Clear water
Old tyres	*Culex* *Aedes*	75 38	Clear water
Total		**720**	

A total of 720 mosquito larvae were collected from different breeding sites. 181 larvae were collected from the gutter and the species collected were *Aedes* (111) and *Anopheles* species (71). 113 larvae were collected from old tyres containing clear water, the species of mosquito contained in the tyre were *Aedes* (57) and *Culex* (29). 167 larvae made up of *Aedes* (61), and *Culex* (101) species were collected from the plastic containers. 178 larvae were collected from the septic tanks and the species of mosquito collected include *Aedes* (65), *Culex* (83) species. The water contained decayed vegetable materials. Also 30 *Anopheles* mosquitoes were collected from abandoned concrete mixer tank.

Table 5: Indoor Resting Adult Mosquitoes collected in the hostel using Pyrethrum Knockdown Method (PKC)

Hostel Blocks	Number of Room	Number of Mosquitoes	Species of Mosquitoes Collected			
			Anopheles gambiae	*Culex quinquefa sciatus*	*Aedes albopictus*	*Aedes egypti*
Block A	16	68	110(20%)	30(44.12%)	10(14.7%)	17(25%)
Block B	19	87	18(20.07)	42(48.27)	16(18.39%)	11(12.64%)
Bloc D	10	30	3(10%)	11(36.67%)	10(33.33%)	6(20%)
P.G. Block	8	16	6(39.5%)	4(25%)	4(25%)	2(12.5%)
Total	**53**	**201**	**38(18.91%)**	**87(43.28%)**	**87(43.28%)**	**36(17.91%)**

53 rooms were sampled in the university hostel (16 rooms in bloc A, 19 in Block B, 10 in Block D and 8 in Postgraduate block). Out of the 201 adult mosquitoes collected indoors (table 5), 68 were from block A, 87 mosquitoes from block B, 30 from block D and 16 from the post graduate block. Among the adult mosquitoes collected indoors, 36(17.91%) were *Aedes egypti,* 87(43.28%) were *Culex quinquefasciatus,* 40(19.90%) were *Aedes albopictus* and 38(18.91%) were *Anopheles gambiae.*

Table 6: Physiological Condition of the Mosquitoes

Hostel Block	Number of Mosquito Collected	Unfed	Blood Fed (%)	Half Gravid (%)	Gravid (%)
Block A	68	16(23.53%)	52(76.47)	31(59.62)	21(40.38)
Block B	87	20(16.25%)	67(83.75)	30(47.78)	37(55.22)
Block D	30	8(26.67%)	22(73.33)	16(72.73)	6(27.27)
P.G. Block	16	3(18.75%)	13(81.25)	8(61.54)	5(38.46)
Grand Total	**201**	**47(23.5%)**	**154(76.6)**	**85(55.19)**	**69(44.81)**

Out of the 201 adult mosquitoes collected (table 6), 47(23.4%) were unfed, 154(76.6%) were blood fed, 85(55.19%) were half gravid and 69(44.81%) were gravid. In hostel block A, 68(76.47%) were blood fed and of these 52(40.38%) were gravid. In block B, 87 mosquitoes were collected, 20(16.25%) were unfed and 67(73.33%) were blood fed, of this 67 blood fed mosquitoes, 30(47.78%) were half gravid and 37(55.22%) were gravid and 22(73.33%) were blood fed. Out of the 22 blood fed ones, 16(72.73%) were half gravid and 6(27.27%) were gravid. In post graduate block (P.G. block), 16 mosquitoes were collected, 3(18.75%) were unfed and 13(81.54%) were blood fed. Out of the 13 blood fed ones, 8(61.54%) were half gravid and 5(38.46%) were gravid.

4. Discussion

The results obtained in this study showed the prevalence of malaria infection among the students in the university hostel of Nnamdi Azikiwe University to be 38.93%. This may be considered low when compared to 67% prevalence recorded for adults in Abakaliki (Ike, 2000), 61% for students in Abuja (Mature *et al.,* 2001) and 59.4% recorded for post primary students in Umunede and Asaba (Ajakoro and Enuma, 1999) most of which were carried out in wet season. 58% prevalence rate was equally recorded in Awka for children aged 0-5 years (Mbanugo and Ejims, 2000). The low prevalence recorded may be due to the fact that the students took precaution and protected themselves against malaria vector by using mosquito nets in most of the rooms.

Prevalence differed in the four different buildings with hostel block D having the highest prevalence rate, 12(43.59%), followed by block A (37.29%) then block B (34.38%) and the post graduate block being hostel with the least prevalence rate (12.11%). These differences based on Chi-square test were statistically non significant. Therefore the differences were due to chance. Looking at the sanitary levels of the various hostels, the general environment were virtually the same with pools of stagnant water and containers with water found everywhere. But in the post graduate block, most of the rooms were protected with mosquito nets and most of the students can afford the cost of insecticide. This may account for

the relatively low prevalence rate recorded in the hostel.

The results also show that out of 90 males and 59 females examined, 39 males (43.33%) were infected with malaria parasite and 19 females (32.20%) were infected. Similar studies at Abuja by Mature *et al* (2001) also recorded higher prevalence in males than the females, 65% prevalence in males and 38% in females. Higher prevalence in males was also recorded in Awka by Mbanugo and Ejims (2000). Higher prevalence in males (87%) than in females (83%) was equally recorded in Okigwe and Owerri both in Imo State, Nigeria (Ukpa and Ajoku, 2001). Although the difference in male and female prevalence is not statistically significant in this study, females have better immunity to malaria and a variety of other parasitic diseases and this was attributed to genetic and humoral factors (Luzzato, 1974). He also observed that genetic factors could play a role by endowing females with immuno-regulatory potential to cope better with some disease infection. However, the higher prevalence in male in this study may equally be attributed to the fact that males exposed themselves more than females especially when the weather is hot and thus are more exposed to the bite of mosquito.

Out of the 201 adult mosquitoes collected indoors at the university hostel, 38(18.90%) *Anopheles* species were recorded. The differences in mosquito abundance in the various hostel blocks were not statistically significant. From the results obtained, it could be said that students residing in the university hostel are exposed to malaria infection and/or other mosquito-borne diseases because the environment is water logged during the rainy season. Mosquito causes more human suffering than any other organisms. Over one million people die from mosquito-borne disease every year (WHO, 2005), therefore constituting the most serious public health problem in Africa.

Although, *Anopheles spp.* encountered in the breeding sites were very few in number, a considerable number was obtained from spray-sheet collection 18.90%. The low abundance of *Anopheles* caught from the breeding sites could be attributed to the environmental conditions of the habitats in the study area. *Anopheles gambiae* breeds in pools resulting from over flows of rivers or mud pools but never in very alkaline or polluted water (Aniedu, 1992). In spite of the number of *Anopheles gambiae* in the study area, there is a cause for public health concern, this is because the species has been described as an efficient vector of malaria (Gillet, 1972). It is therefore necessary to protect the students from mosquito-borne infections through sanitary improvements such as filling and draining of gutters, proper disposal of materials that can hold water results in permanent elimination or reduction of *Anopheles* breeding sites. Also the students should be advised to use insecticide-treated nets to reduce the number of mosquito bites inside the hostels (Onyido et al., 2011b). Screens can also be installed in hostels. More importantly effective health education programme on the mode of infection of malaria should be made available to students or may be included in the scope of work of every academic discipline in the school. A good knowledge of the disease agents and their modes of transmission and how to prevent them will go a long way towards reducing the prevalence.

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9/10/2012