ASSESSMENT OF NATURAL AND ARTIFICIAL BREEDING SITES OF MOSQUITOES IN RURAL AND URBAN AREAS OF ABEOKUTA, OGUN STATE, NIGERIA

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ABSTRACT: The frequent surveillance of the mosquito breeding sites has been identified as one of the veritable tools towards planning effective anti-mosquito measures. This study assesses the occurrence and the distribution of the natural and artificial breeding sites of mosquitoes in the rural and urban areas of Abeokuta, Ogun State, Nigeria. Ten different larval habitats were encountered of which bamboo stumps and block moulds constituted the most abundant breeding sites in the rural areas while discarded car batteries constituted the most important breeding sites in the urban areas. The species encountered were *Aedes aegypti, Ae. albopictus, Ae. longipalpis, Ae. simpsoni, Ae. vittatus, Anopheles gambiae complex, Culex quinquefasciatus, Cx. tigripes, Eretmapodite chrysogaster, Ae. domesticus, Coquilletidia maculipennis*. There was no significant difference in the distribution of mosquito species in the rural and urban areas ($p>0.05$), but the species occurrence was significantly higher in the artificial breeding sites relative to the natural breeding sites ($p<0.05$). The high occurrence of the mosquito vectors in the artificial breeding sites, most importantly the discarded materials calls for the mass public health awareness on the human activities that promote the breeding of mosquito vectors in the study area.

KEY WORDS: Mosquitoes, breeding sites, rural, urban, Nigeria.

Malaria and other mosquito-borne diseases still remain the challenging public health problems in Africa (Banjon et al., 2009). One of the factors probably promoting the persistent transmission of the diseases in the region is premised on the vast larval habitats available for mosquito vectors which ensure prolific and continuous breeding of the vectors (Adebote et al., 2008). Mosquitoes exploit varying aquatic habitats for breeding depending on the species of mosquitoes and the conduciveness of the habitats (Mafiana et al., 1998). These habitats, which consist of natural and artificial sites, are most often neglected while colossal resources are being channeled towards controlling the adult mosquitoes (Aigbodion & Anyiwe, 2005).

The increasing rate of urbanization and agricultural development in both rural and urban parts of Nigeria has been inundated with many public health problems (Amusan et al., 2005). These problems, most often emanate from inadequate waste disposal, irrigation, poor drainage and many others. The presence of one or a combination of these factors may lead to the creation of congenial environment for the breeding of mosquitoes which are responsible for the transmission of many deadly and life-threatening diseases such as malaria, filariasis, dengue and yellow fever (Anyanwu et al., 1999). Thus, the proper environmental audit is germane for effective control of mosquito vectors (Adebote et al., 2008).

Though, previous studies on mosquito fauna in Abeokuta had shown that the environmental and climatic conditions of the town offer ample opportunity for the survival of diverse species of mosquitoes (Mafiana et al., 1998; Adeleke et al., 2008), the species composition and the breeding habitats of mosquito fauna in rural areas adjoining the metropolis are still largely unknown in the literature. Mosquitoes are great fliers and rural -urban disease transmission is possible (Amusan et al., 2005). Therefore, the planning of successful anti- mosquito measures in the area encompasses the complete knowledge of the potential breeding sites in the town and the adjoining rural areas. It is against this background that the present study was designed to assess the breeding sites and the species composition of mosquito fauna in rural and urban areas of Abeokuta, Ogun State, Nigeria.

MATERIALS AND METHODS

Study area

The study was conducted in Abeokuta (7° 10N, 3°21E) and the adjourning rural areas. Abeokuta lies in the transitional zone between the tropical rainforest and derived savannah zone in the Southwest, Nigeria. The area experiences two seasons, the dry season (November to March) and the wet season (April to October).

Larval sampling

The larval sampling of all accessible breeding sites was carried out once weekly between July and October, 2010 in five rural areas; Alabata, Isolu, Odeda, Osiele and Olugbo and five randomly selected areas in Abeokuta metropolis ; Isale-Igbein, Isale Ake, Obantoko, Lafenwa and Idi –Aba . The locations represent different divisions in the city. The microhabitats surveyed include puddles, vehicle tyres, septic tank, gutters, domestic plastic containers, bamboo stumps, old discarded vehicle batteries, run-offs, block moulds and the polythene bags. The mosquito larvae were collected with plastic scoopers and sieves of about 0.55mm mesh –size. In occasions that the larvae were not identified immediately, the samples were stored in 70% alcohol and kept in 4°C.

Larval identification

All larvae were identified with the aid of dissecting microscope (Cole Parmer) using the keys described by Hopkins (1953). Some larvae were allowed to emerge into adult inside mosquito cage and later identified using the keys described by Gillet (1972).

Data analysis

The data obtained were analyzed using SPSS. Student t-test and Analysis of Variance were used to determine the significant differences in habitat and species distribution at the study sites.

RESULTS

Distribution of the breeding sites in both rural and urban areas

Table 1 shows the distribution of the breeding sites encountered in both rural and urban areas during the study. Of 693 breeding sites encountered (384 in the rural and 309 in the urban), 327 (54.83%) were positive for mosquito larvae. The breeding sites encountered include puddles, vehicle tyres, septic tank, gutters, domestic plastic containers, bamboo stumps, old discarded vehicle batteries, run-offs, block moulds and the polythene bags. Bamboo stumps and block moulds constituted the most important breeding sites in the rural area (100% positive) followed by discarded tyres (96.92%) and the discarded batteries (90.69%). The plastic containers contributed the least (30%). In the urban areas, old discarded batteries were the predominant breeding sites (59.385), followed by discarded tyres (50.76%) while old discarded plastic was the least (13.92%). There was significant difference in the distribution of mosquito breeding sites in both rural and urban areas ($p<0.05$). However, the tadpoles and some species of crusteaceans were encountered at the negative sites.

Species occurrence at the breeding sites in both rural and urban areas

A total of eleven species were encountered in the artificial and natural breeding sites in both rural and urban areas. The species encountered were *Aedes aegypti, Ae. albopictus, Ae. longipalpis, Ae. simpsoni, Ae. vittatus, Anopheles gambiae complex, Culex quinquefasciatus, Cx. tigripes, Eretmapodite chrysogaster, Ae. domesticus, Coquilletidia maculipennis*. All the species were found in both rural and urban areas with exception of *Cq. maculipennis* which was only found in the urban area. There was no significant difference in the species distribution in both rural and urban areas ($p>0.05$). The species composition was significantly higher ($p<0.05$) in the artificial breeding sites as compared with natural breeding sites. The artificial breeding sites harboured all the species encountered at the rural and the urban areas. The natural breeding sites harboured only seven (7) species namely *Ae. aegypti, Ae. longipalpis, Ae. simpsoni, Ae. vittatus, Cx. quinquefasciatus, Cx. tigripes and Er. chrysogaster* in the rural area. Four species of mosquitoes namely, *Ae. aegypti, Ae. longipalpis, Er. chrysogaster* and *An. gambiae* complex were encountered in the natural breeding sites in the urban area. There was significant variation ($p<0.05$) in species occurrence of mosquitoes encountered at the breeding sites. *Ae. aegypti* was the most abundant species and had over 80% occurrence in all the breeding sites followed by *Cx. quinquefasciatus* which was also found in all the breeding sites but at lower occurrence. However, apart from *Ae. aegypti* and *Cx. quinquefasciatus* which occurred at all the breeding sites, other mosquito species were restricted to some breeding sites. *An. gambiae* complex was found only in the septic tank and the puddles (Table 2). Domestic plastics and water storage facilities harboured the highest number of species (9 out of 11) followed by tyres, old discarded batteries and gutters (8) while polythene bags harboured the least (1) species. The variation observed in the number of species encountered at the different breeding sites was statistically significant ($p<0.05$).

DISCUSSION

The proper assessment of mosquito breeding sites becomes necessary in the recent event of the persistent transmission of mosquito-borne diseases in different parts of the world. Some of the major determinants of the mosquito larval distribution are the size and nature of the breeding sites, physico-chemical parameters of the sites, rainy pattern and the presence/ absence of the predators (Adebote et al., 2008). The average number (54.83%) of productive (positive) sites recorded among the potential breeding sites sampled could be due to the flooding and the presence of predators such as tadpoles and crustaceans observed in many of the unproductive breeding sites. However, the significant difference in species occurrence in the artificial and the natural breeding sites may not be unconnected with the differences in the number of the breeding sites encountered and/or the breeding habitat selection of the mosquitoes (Adebote et al., 2008; Adeleke et al., 2008). The latter factor would have plausibly accounted for the low occurrence of the *An. gambiae* complex recorded in this study since the species usually prefers ground pools and other natural breeding sites (Adeleke, 2003; Adeleke et al., 2008). Apart from *Ae. aegypti* which breeds indiscriminately, other species of *Aedes* have been known to prefer man-made (artificial) breeding sites. The breeding of *Cx quinquefasciatus* in all the breeding sites shows that most of the breeding sites are polluted since the species had been known to breed exclusively in polluted water (Mafiana et al., 1998).

The preponderance of the artificial breeding sites, most importantly the discarded materials in the present study revealed the poor sanitary conditions of Abeokuta metropolis. This is similar to the earlier observations by Adeleke et al. (2008). The effects of these attitudes, if remain unabated, could culminate in outbreak of some re-emerging mosquito-borne diseases when considering the vectorial capacities of most of the species encountered. *Aedes* mosquitoes have been implicated in the transmission of dengue and yellow fever (Anyanwu et al., 1999; Adebote et al., 2008, 2009; Adeleke et al., 2010) while *Cx. quinquefasciatus* is an efficient transmitter of bancroftian filariasis in Africa (Adeleke et al., 2010).

Though, the occurrence of *An. gambiae* complex (the principal vector of malaria in Africa) encountered in this study is low, the breeding of the species in the septic tank (man-made) is remarkable as such site is less targeted for source reduction of malaria vector during larval control activities. The constant surveillance of such unexpected breeding sites is imperative for source reduction (larval reduction) in other to stem the high transmission of malaria of which Abeokuta has been known to be hyperendemic to the disease (Ojo & Mafiana, 2001). Apart from transmitting malaria, *An gambiae* complex has also been implicated in the transmission of bancroftian filariasis in many rural areas of Africa (Anosike et al., 2003). Though the sizeable distribution of *Cq. macullipennis* and *Er. chysogaster* was observed in this study, the two species had never been reported to transmit any disease in Africa.

Conclusion and recommendation

The present study reported the prolific breeding of mosquito vectors in artificial breeding sites, most importantly the unwanted receptacles due to the poor sanitary conditions in both rural and urban areas. There is therefore need for mass public health education for the improved environmental sanitation so as to reduce the breeding sites of potential mosquito vectors in Abeokuta and the adjoining rural communities.

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Table 1. Occurrence of the mosquito breeding sites in the rural and urban areas of Abeokuta.

Breeding sites	Rural No sampled	Rural No(%) positive	Urban No sampled	Urban No(%) positive	Total No sampled	Total No(%) positive
Puddles	50	23(46)	40	9(22.5)	90	32(35.55)
Vehicle tyres	65	63(96.92)	65	33(50.76)	130	96(73.85)
Septic tanks	71	54(76.06)	55	15(27.27)	126	69(54.76)
Gutters	15	10(66.66)	28	13(46.42)	43	23(53.48)
Discarded plastic containers	70	21(30)	79	11(13.92)	149	32(21.48)
Bamboo stumps	14	14(100)	0	0	14	14 (100)
Discarded vehicle batteries	43	39(90.69)	32	19(59.38)	75	58(77.33)
Polythene bags	0	0	10	3(30)	10	3(30)
Block moulds	33	33(100)	0	0	33	33(100)
Run-offs	23	20(86.96)	0	0	23	20(86.96)
Total	384	277(72.13)	309	103(33.33)	693	380(54.83)

Table 2. Species composition and occurrence of mosquito species at the productive breeding sites in both rural and urban areas of Abeokuta.

Breeding sites	Species	No of positive sites	No (%) of occurrence
Puddles	*Aedes aegypti*	32	32 (100)
	Ae.vittatus		10 (31.25)
	Ae simpsoni		3(9.38)
	Ae. longipalpis		13(40.63)
	Anopheles gambiae complex		6(18.75)
	Culex quinquefasciatus		14(43.75)
	Eretmapodite chrysogaster		11(34.38)
Gutters	*Ae. aegypti*	23	19(82.26)
	Ae.vittatus		9(39.10)
	Ae simpsoni		5(21.74)
	Ae. longipalpis		4(17.39)
	Ae. domesticus		3(13.04)
	Cx. quinquefasciatus		17(73.91)
	Cx. tigripes		7(30.43)
	Er. Chrystogaster		12(52.17)

Tyres	*Ae. aegypti* *Ae.vittatus* *Ae simpsoni* *Ae. longipalpis* *Ae. albopictus* *Cx. quinquefasciatus* *Er. Chrysogaster*	96	86(89.58) 72(75.00) 17 (17.71) 20(20.83) 2(2.08) 58(60.42) 29(30.21)
Septic tanks	*Ae. aegypti* *Ae.vittatus* *Ae simpsoni* *Ae. longipalpis* *Ae domesticus* *An. gambiae complex* *Cx. quinquefasciatus* *Er. Chrysogaster*	69	69(100) 28(40.57) 6(8.69) 36(52.17) 2(2.89) 2(2.89) 69(100) 7(10.14)
Discarded plastic containers	*Ae. aegypti* *Ae.vittatus* *Ae simpsoni* *Ae. longipalpis* *Ae. albopictus* *Ae. domesticus* *Cx. quinquefasciatus* *Er. Chrysogaster* *Coq macullipennis*	32	28(87.96) 23(71.88) 13(46.87) 22(68.75) 8(25.00) 3(9.38) 13(46.87) 7(21.88) 2(6.25)
Discarded batteries	*Ae. aegypti* *Ae.vittatus* *Ae simpsoni* *Ae. longipalpis* *Ae. domesticus* *Cx. quinquefasciatus* *Er. Chrysogaster* *Coq macullipennis*	58	47(81.03) 34(58.62) 3(19.33) 20(34.48) 6(0.34) 22(37.93) 19(32.75) 11(18.97)
Bamboo stumps	*Ae. aegypti* *Cx quinquefasciatus*	14	14(100) 13(92.81)
Run-offs	*Ae.aegypti* *Ae. vittatus* *Ae. Albopictus* *Cx. quinquefasciatus* *Cx. tigripes* *Er. Chrystogaster*	23	20(86.96) 19(82.61) 5(21.74) 8(34.78) 9(39.91) 19(82.61)
Polythene bags	*Ae. aegypti* *Cx. quinquefasciatus*	3	3(100) 3(100)
Block moulds	*Ae. aegypti* *Ae.vittatus* *Ae. simpsoni* *Cx. quinqurfasciatus* *Er. Chrysogaster*	33	33(100) 13(39.39) 5(15.15) 21(63.64) 18(54.55)