Seasonal pattern of Bancroftian Filariasis transmission in Ebonyi State, Nigeria

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Bancroftian filariasis in Nigeria is endemic with 22.1% of the population thought to be infected. The main mosquito genera implicated with Wuchereria bancrofti transmission are Anopheles and Culex. The study was carried out to compare the infectivity rates of the vectors between the high transmission (rainy) and the low transmission (dry) seasons. Mosquitoes were sampled from houses and compared from six sentinel villages (3 each from Ohaukwu and Abakiliki Local Government Areas) of Ebonyi State, Nigeria. Day resting indoor collection (DRI) by Aspirator and Pyrethrum Spray Catch (PSC) were used to collect mosquitoes between 7:00 and 11:00am. After morphological identification, female parous mosquitoes were dissected in search for infective (L3) larvae of W. bancrofti. A total of 4,840 female mosquitoes were dissected. More mosquitoes were caught in the rainy season than in the dry season. Infectivity rates of vectors in Ohaukwu villages were 3.54 and 5.41% in the rainy and dry seasons, respectively, whereas in Abakiliki villages these were 1.85 and 1.19%, respectively. There was no significant difference in the overall infectivity rates between the two seasons in both Ohaukwu and Abakiliki villages (p>0.05). Similarly, no significant difference in the total/average transmission potentials were found between the seasons (p>0.05). Anopheles gambiae s.l was the main vector in both study sites followed by an Anopheles funestus and Culex quinquefasciatus. There was a difference in infectivity rates of Anopheles species between the wet and dry seasons (p<0.05), whereas no significant difference exist in infectivity rates of Anopheles species and Cx. quinquefasciatus (p>0.05). Findings were discussed in the context of on-going plans to eliminate filariasis and the transmitting vectors.

Key words: Bancroftian filariasis, rainy season, dry season, Wuchereria bancrofti.

INTRODUCTION

Wuchereria bancrofti which causes bancroftian filariasis is the only etiologic agent in Africa (Michael and Bundy, 1997). The disease is prevalent and widespread in Nigeria which is the third most endemic country in the world (after India and Indonesia) and estimated 22.1% of the population is thought to be infected (Eigege et al., 2003).

The epidemiology of the disease regarding the abundance of the proven vectors (Anopheles and Culicine species) is somewhat different when compared with other ecological zones of the world.

In Nigeria, the prevalence of bancroftian filariasis or (filariasis index) between the northern parts with lowest

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rainfall and southern parts with highest rainfall parts vary considerably (Nwoke, pers. Communication, 2007). However, no explanation was offered to these findings regarding vector infectivity or infection rates. Studies elsewhere have revealed that the peak transmission of filariasis was during the long rains and after the short rains in Mambru and Jaribuni villages of Kenya (Wijers and Kinyanjui, 1977). The hot dry season transmission was interrupted in Mambru, but was rather low in Jaribuni. Wijers and Kaleli (1984) in related study concluded that transmission season coincides with the long rain during which filariasis vectors were in abundance. However, no clear reports on comparison between vector infectivity rates between the seasons were shown.

Clearly, further work is urgently needed to evaluate the exact importance of both the vector capacities and seasonal filariasis transmission in parts of Africa. In Nigeria limited works exist on vector infectivity infection rates both natural and experimental (Anosike et al., 2003; Mbah, 2010; Awolola et al., 2006; Amaechi, 2009). Infectivity and infection studies of mosquitoes on filariasis between the dry and wet seasons are lacking. The present study therefore examines the seasonal infection/infectivity rates in rural endemic areas of Ebonyi State, Nigeria.

MATERIALS AND METHODS

Study sites

The study was conducted in six (6) sentinel villages, three (3) each from Ohaukwu (Orijiriafor, Okpochiri and Ndiagu Obu) Abakiliki (Mgbabeluzo, Okarie Echida and Okpochiri) Ebonyi State, Nigeria (7°31’-8°18’N- 50°36’- 6°15’E) Figure 1. The ecology of the area has been described in details (Amaechi et al., 2010; Richards et al., 2013). The inhabitants are Igbo who mainly live in mud walled and thatched houses. Houses with block walls and or iron sheets roofing are extremely rare. They are peasants growing mainly maize, rice, yam and cassava. Livestock kept includes cattle and goats with some animals tethered inside human dwellings. The sites were selected based on preliminary ICT-survey (Carter Center, 2009. Unpublished data) indicating the presence of bancroftian filariasis in the area.

ETHICAL CONSIDERATION

Ethical clearance and permission was approved by the Post Graduate Research Board of the Zoology Department of Imo State University. Owerri, Nigeria and Ebonyi State Ministry of Health. Team members were trained on entomological survey methods. Informed verbal consent was obtained from residents of household on mosquito collections.

Mosquito sampling technique/laboratory processing

The prevalence of infective mosquitoes was assessed in households. Houses were visited twice monthly during the mornings and indoor resting mosquitoes were collected by pyrethrum spray catch (PSC) and mechanical aspirator (WHO, 2002). The time and period of collection were chosen to catch fully engorged vectors and reflected the seasons (rainy and dry) of the areas. As much as possible houses were of similar construction to avoid the effect of variability. Indoor resting mosquitoes were collected in 20 selected houses and at least one sleeping room in each house was used for mosquito collection (Mboera et al., 2006). Mosquitoes caught were taken to a temporary dissection center as time allowed. Visual identification (for morphology) was made using different keys and characteristics (Nwoke, 2007, unpublished).

Blood fed females were dissected to determine parity by observing the degree of ovarian trachioles (Detinova, 1962). The body parts (head and mouth parts, thorax and abdomen) were macerated and examined for the presence of living filarial larvae. For more exact identification of filarial larval stages and species, the preparations were stained with haematoxyline (Nelson, 1959) and examined with microscope. Recovery of larval stages of W. bancrofti was done according to Nelson and Pester (1962); larval stages were categorized by sizes rather than by appearances (Nathan, 1981).

Statistical analysis

Data were analyzed by chi square using Epi Info 6 computer software statistical analysis programme to compare the infectivity rates of the vectors between the rainy and dry seasons. Yates correction was also used to compare infectivity rates of the vectors; the sentinel villages and the mosquito vector species.

RESULTS

Cumulatively, 4,840 blood fed mosquitoes were dissected. Table 1 shows that infection and infectivity rates of the vectors were (8.82% versus 15.22%) and (3.54% versus 5.41%) in the rainy and dry seasons, respectively. Table 2 shows the infection and infectivity rates of LF vectors in Abakiliki. Infection and infectivity rates were found to be 2.30% versus 1.62% and 1.85% versus 1.19% for rainy and dry seasons. Infectivity rates differed significantly between the rainy and dry seasons in Ohaukwu (p<0.05) but not in Abakiliki (p<0.05). In both seasons and study sites, Anopheles gambiae was the predominantly species (Tables 1 and 2).

Considering the infectivity rates of the vectors independently, the order of vector importance of the three main vectors in Ohaukwu and Abakiliki was A. gambiae, Anopheles funestus and Culex quinquefasciatus (Tables 1 and 2). This was the same trend in both seasons. Statistical significant difference in infectivity rates were found between Anopheles species (p<0.05). However, no significant difference existed between infectivity rates of Anopheles spp. and Cx. quinquefasciatus (Table 3). The highest number of infective larvae (L3) per mosquito in Ohaukwu was 5 with an average of 5 which occurred in the rainy season. In Abakiliki, the highest number of infective larvae per mosquito was 4 (An. gambiae) with an average of 2 during the rainy season. There was only one infective larva of Cx. quinquefasciatus which
occurred during the dry season. No significant difference in the total/average transmission potential ($TP^*$) were observed between the seasons ($p<0.05$).

**DISCUSSION**

Although the Pyrethrum Spray Catch (PSC) and Mechanical Aspirator (MA) method records only the mosquitoes that rest indoors, it is widely used for estimating the abundance, seasonal densities, host preference and vector infection status as in this study. Previous study has shown that mosquito infectivity rates are low during the dry season and high in the rainy season. However, this was not the case for both study sites: Orijiriafor, Okpochiri, Ndiagu Obu rural villages in Ohaukwu and Mgbabeluzor, Okarie Echida and Obeagu Ibom villages towns in Abakiliki. This observation contradicted those of Kasili et al. (2009) in Kenyan Coast and in Philippines (Valeza and Grove, 1979) and could
be attributed to human behavior and difference in ecological settings. Abakiliki, though not urbanized settlement has had resulting sanitary conditions due to shift in ecology/gradual modified ecology from rural to rural/urban. The state capital is few kilometer away from these villages resulting in improved economic status through trading and rapid transportation of farm products. These could explain the parity in infectivity rates.

The only significant difference in infectivity rates of vectors was between *Anopheles* species (*An. gambiae* sl and *An. funestus* sl) in both seasons. Similar observation have been observed elsewhere by Manyi et al. (2016). These observations probably depicted *Anopheles* spp. as the most important bancrofti filariasis vectors in terms of infectivity rates. Similar findings were reported at other sentinel sites of Nigeria (Amadi and Udonsi, 2004; Mbah, 2010; Awolola et al., 2006). Thus, confirmation of evidence that their infectivity status has not changed in rural African communities in the last seven decades (Taylor, 1930; Kuhlow, 1987). The increase in number of *Anopheles* spp. in both Ohaukwu and Abakiliki accounted for infectivity rates in the seasons. Previous reports has

<table>
<thead>
<tr>
<th>Mosquitoes species</th>
<th>Number</th>
<th>No. containing larvae stages</th>
<th>Rates (%)</th>
<th>TP*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parous</td>
<td>Infection</td>
<td>Infective</td>
<td>Diss</td>
</tr>
<tr>
<td><strong>Rainy season</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>An. gambiae</em> sl</td>
<td>1,348</td>
<td>1,085</td>
<td>44</td>
<td>24</td>
</tr>
<tr>
<td><em>An. funestus</em> sl</td>
<td>363</td>
<td>243</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td><em>Cx. quinquefasciatus</em></td>
<td>66</td>
<td>31</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Mn. africana</em></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Ae. aegypti</em></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1,780</td>
<td>1,361</td>
<td>48</td>
<td>30</td>
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<thead>
<tr>
<th>Mosquitoes species</th>
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<tbody>
<tr>
<td></td>
<td>Parous</td>
<td>Infection</td>
<td>Infective</td>
<td>Diss</td>
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<tr>
<td><strong>Dry season</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><em>An. gambiae</em> sl</td>
<td>731</td>
<td>699</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td><em>An. funestus</em> sl</td>
<td>168</td>
<td>146</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td><em>Cx. quinquefasciatus</em></td>
<td>99</td>
<td>58</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Mn. africana</em></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Ae. aegypti</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>999</td>
<td>904</td>
<td>39</td>
<td>32</td>
</tr>
</tbody>
</table>
shown that An. gambiae ss mosquito predominate in rainy season whereas Anopheles arabiensis in the dry season. The predominant status of An. gambiae in both seasons demands for identification beyond morphological criteria to ascertain the contribution of sibling species in filariasis transmission.

Cx. quinquefasciatus when compared with An. gambiae, An. funestus was few in number with low infectivity rate(1.09%) found only in the dry season. Wijers (1977) have found them to have reduced longevity. By implication, even if the number could be high as observed herein, very few may live to support W. bancrofti larvae. This could account for its low contribution to infectivity rates. Previous works have posited that it is an urban vector Manyi et al (2014) in Makurdi (North Central, Nigeria) found high infectivity rates in Anopheles and its involvement together with Anopheles spp. in Abakiliki further supports changed sanitary condition of the area. There has been large population movement in the South Eastern part of Nigeria as a result of human workforce (labour). Ebonyi population has been actively involved in this process. Therefore, the introduction of W. bancrofti into other areas is possible and because of the abundance and compatibility of the parasite and vectors the infection might well become established in the local population that is not at present a focus for bancrofti filariasis.

In both Ohaukwu and Abakiliki, A. gambiae was more abundant in the rainy season than in the dry season. The number of A. funestus in Ohaukwu and Abakiliki declined during dry season because their breeding sites were mainly clear water and vegetation near the water sources which were rare in the dry season. The observed proportions of Culex in both sites and seasons were due to open polluted water trenches which ramify throughout the area (foul water bodies for cassava fermentation and local sponge making from palm oil heads). In the dry months, they are filled with larvae and pupae of Culex mosquitoes whereas pit latrine became water-logged in the rainy seasons thus providing excellent breeding sites for Culex mosquitoes.

Apparently, the abundance of these vectors was due to prevailing weather conditions; rains with large numbers appearing during the long rains and very few during the drier months. In both sites, Culex was present though not the most important in the transmission of W. bancrofti. Therefore, it appears that the great risk of infection from infective mosquitoes in both Ohaukwu and Abakiliki is due to the bites of An. gambiae and An. funestus. Though, it has been noted that Culex is an urban vector and could serve as a potential vector for urban cities (Onwuliri and Anosike, 1989). Results of this study have shown Culex to be a contributing vector of filariasis transmission.

Mansonina africana (non-filarial vector in Nigeria) and Aedes aegypti were encountered, indicative of the level of nuisance, the inhabitants of the area got from these mosquitoes. Their dissection results probably reflected feeding habit and anatomical variation rather than absence of W. bancrofti.

The transmission potentials (TP*) were comparable for both seasons and clearly indicated no changes in vector-contact rates with infected people. The difference in vector infectivity rates between the seasons is independent on vector abundance but the actual species of the mosquito vector. The results of this study therefore revealed that there is a difference between the rainy and dry seasons and the abundance of An. gambiae sl and An. funestus sl in rainy seasons could be the main reasons for this. The implication of these findings to the Nigerian Lymphatic Filariasis Elimination Programme in vector control cannot be overemphasized.

**CONFLICT OF INTEREST**

The authors have not declared any conflict of interest

**REFERENCES**


