ENTOMOLOGICAL AND TRANSMISSION RISK INDICES OF MALARIA VECTORS IN SELECTED COMMUNITIES IN OSUN STATE, NIGERIA

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ABSTRACT

Baseline survey is an integral component of a malaria vector control programme, providing valuable information on mosquito behaviour that guide the suitability of chosen interventions. A need assessment of baseline entomological indices towards the future implementation of indoor residual spray (IRS) was conducted in Osun State, Nigeria. Indoor resting mosquitoes were collected in human households from three Local Government Areas. These were morphologically identified, subjected to species specific polymerase chain reaction (PCR) assay and analyzed for sporozoite infection and blood meal origin using enzyme linked immunosorbent assay (ELISA). All female Anopheles identified fed on human blood but tested negative to Plasmodium falciparum circumsporozoite antigen. The PCR analysis showed a predominance of An. gambiae s.s. (95%) over An. arabiensis (5%). The preponderance of indoor resting An. gambiae s.s and the incidence of exophilic An. arabiensis suggest a combination of IRS and long lasting insecticidal nets (LLINs) for this region.

Keywords: Malaria vectors, Transmission risk indices, Species specific PCR, *Plasmodium falciparum, Circumsporozoite antigen,* Long lasting insecticidal nets, Osun State, Nigeria

INTRODUCTION

Baseline entomological studies provide needful information that guide the suitability of malaria vector control interventions. Indoor residual spray (IRS) is a proven malaria vector control intervention which involves overlaying the walls of human dwellings with a residual class of insecticide approved by the World Health Organization. In a bid to determine the appropriateness of IRS as a malaria control strategy in Osun State, a need assessment on the identity and behavior of malaria transmitting mosquitoes in selected communities was undertaken. To our knowledge, Osun state has no baseline information of this kind in literature except for the recent identification of mosquito larval habitats in Osogbo, the State Capital (Adeleke *et al.,* 2013). To this effect, a cross sectional study to identify malaria vector sibling species and characterize their indoor resting and feeding behaviour was conducted in three Local Government areas of the State.

MATERIALS AND METHODS

Osun State has a land area of 8,802 square kilometers and a population of 3,423,535 (NPC,

2006). The annual rainfall is between 800 mm and 1500 mm with mean annual temperature of 21.1 ^{o}C to 31.1^{o}C (Akinola and Owombo, 2012). Three communities Odeyinka (longitude 07° 19′ latitude 004° 22′), Egbeda (longitude 07° 47′ latitude 004° 39′) and Iwikun (longitude 07° 33′ latitude 004° 44′), from three Local Government areas of Irewole, Boripe and Atakumosa East, respectively were randomly selected for the study. The officials of the State Ministry of Health upon the consent of the Ministry organized community group meetings in the study villages to educate the people on the importance of the study. Informed consent of the head of each house to be sprayed for mosquito collection was also obtained before the spray catches were conducted. In each community, either 12 or 14 housing units were randomly selected for anthropophilic mosquito sampling in January 2012, using pyrethrum spray collection (PSC) techniques (WHO, 2003). Mosquito samples collected were preserved over desiccated silica gel in eppendorf tubes for further morphological identification (Gillies and Coetzee, 1987). Samples identified as belonging to the *An. gambiae* complex were subjected to species specific PCR assay (Scott *et al.,* 1993) to ascertain their sibling species identity. Malaria transmission risk indices or parameters evaluated include indoor resting densities, man-biting rates, sporozoite infection rates and blood meal origin or host preference of the vectors. The numbers of people who slept overnight in the rooms sampled for mosquitoes were recorded for estimation of man-biting rates (MBR). Man-biting rates were therefore estimated as the total numbers of fed *Anopheles* mosquitoes divided by the total number of people who slept overnight in the rooms where mosquitoes were collected multiplied by the human blood index (Githeko *et al.,* 1993). The human blood index (HBI) represents the total number of *Anopheles* mosquitoes found with human blood divided by the total number of *Anopheles* mosquitoes with blood, while indoor resting densities were taken as the number of female *Anopheles* mosquitoes divided by the number of rooms surveyed (WHO, 2003).

Anopheles samples collected were also identified for blood meal origin (Beier, 1988) and *Plasmodium falciparum* infection (Wirtz *et al., 1*987) using Enzyme Linked Immunosorbent Assay (ELISA). Percentages and analysis of variance (ANOVA) were used to compare the results obtained from the three communities. The level of significance was p = 0.05.

RESULTS

A total of 29 mosquitoes were collected in all the three communities. Of these, 23(79%) were *Anopheles*, while the remaining 6(21%) were *Culex* spp 2(7%) and *Culiseta* spp 4(14%). The numbers of *Anopheles* mosquitoes observed in Odeyinka community 11(47.8%) were more than those observed in Egbeda 4(17.4%) and Iwikun 8(34.8%) communities (Table 1). The HBI obtained was one (1) since all the *Anopheles* mosquitoes were found to have fed on human blood. High IRD and MBR of 0.79 and 0.37, respectively was recorded in Irewole Local Government Area than in Boripe Local Government Area with IRD and MBR of 0.29 and 0.13, respectively (Table 1). Analysis of variance carried out indicated that the IRD and MBR values among the communities were not significantly different (p>0.05). Ninety-six percent of the entire *Anopheles* mosquitoes identified were *An. gambiae* s.l, while 4% were *An. dancalicus* identified only in Egbeda community (Table 1). The entire female *Anopheles* fed on human blood and tested negative to *P. falciparum* circumsporozoite antigen. The PCR analysis showed only one *An. arabiensis* (5%) found in Iwikun community, while all other samples 21(95%) were *An. gambiae* s.s (Table 2).

DISCUSSION

The low numbers of *Anopheles* mosquito samples recorded in the study communities was due to the dry season period in which the study was conducted. This is the best period for IRS before the onset of rainfall when the number of mosquito increases. The insignificant differences in the number of *Anopheles* mosquitoes collected in the study areas indicated similarities

Table 1: Indoor resting densities and man-biting rates of *Anopheles* mosquitoes in three communities of Osun State, Nigeria

Community	Number of rooms surveyed	Number of sleepers	Number of fed female *Anopheles*	Average IRD of *Anopheles*	Average *Anopheles* bite/person /night	*Anopheles* species composition	
						An. gambiae s.l	*An. dancalicus*
Odeyinka	14	30	11(47.8)	0.79±1.37	0.37±0.99	11	0
Egbeda	14	30	4(17.4)	0.29±0.61	0.13±0.43	3	1
Iwikun	12	24	8(34.8)	0.67±1.44	0.33±1.04	8	0
Total	40	84	23	1.66±3.42	0.79±2.46	22(96)	1(5)

Numbers in parenthesis are the percentages composition

Table 2: *Anopheles* species and sibling species composition in the three communities of Osun State, Nigeria

Community	*Anopheles gambiae* sibling species composition	
	An. gambiae s.s	*An. arabiensis*
Odeyinka	11	0
Egbeda	3	0
Iwikun	7	1
Total (%)	21(95)	1(5)

Numbers in parenthesis are the percentages composition

in their environmental factors. The presence of other non-malaria vectors is suggestive of the level of nuisance experienced by the inhabitants of these areas. The preponderance of the *An. gambiae* group in this study is attributable to their anthropophilic behavior. Awolola *et al.* (2002) had earlier identified *An. gambiae* s.s and *An. arabiensis* as the major vectors of malaria in Nigeria. Similarly, the predominance of the *An. gambiae* s.s over *An. arabiensis*, in this study is in consonance with the findings of Oduola *et al.* (2012) who reported a significantly higher ($p<0.05$) proportion of *An. gambiae* s.s compared to An. arabiensis in Oyo State, Nigeria. Only one *An. arabiensis* was found in this study at the peak of the dry season. This may have attested to its exophilic nature, adaptation to arid zones (Onyabe and Conn, 2001) or an actual dominance of *An. gambiae* s.s in these regions all year round. The non-occurrence of *P. falciparum* infection (zero sporozoite rate) in all the samples collected, could be attributed to the cross-sectional nature of the study and the low number of samples arising from the peak period of dry season in which the survey was conducted, and therefore does not mean that there is no malaria transmission in these areas as at the time of the study. Apart from low number of samples (indoor resting densities) and the non-occurrence of sporozoite, other malaria transmission risk parameters or indices such as blood meal origin show that all the species of *Anopheles* mosquitoes in this area prefer human blood. For this reason, sympatric occurrence in Iwikun of *An. gambiae* s.s and *An. arabiensis*, the major malaria vectors in Nigeria, is a necessary precondition for the introduction of an integrated vector management programme in Osun State, Nigeria. The predominance of indoor resting *An. gambiae* s.s and the incidence of exophilic *An. arabiensis* suggest a combination of IRS and LLINs for effective malaria vector control in Osun State, Nigeria.

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