Early Biting of the Anopheles Gambiae S.S. and its Challenges to Vector Control Using Insecticide Treated Nets in Western Kenya Highlands

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Abstract

Long term use of insecticides in malaria vector control has been shown to alter the behavior of vectors. Such behavioral shifts have the potential of undermining the effectiveness of insecticide-based control interventions. The effects of insecticide treated nets (ITNs) use on the composition, biting/feeding and sporozoite rates of Anopheles gambiae s.l. mosquitoes in Musilongo village, Vihiga County of western Kenya highlands were investigated. Adult mosquitoes were collected in selected sleeping spaces inside six randomly selected houses using miniature Centre for Disease Control and Prevention (CDC) light traps. Mosquito sampling in each house was conducted twice every week for 16 consecutive months (May 2010–August 2012). At each sampling a single trap was set in the selected space inside each house such that it collected mosquitoes alternatively from 18:00 to 21:00 h and 21:00 to 06:00 h every week. All collected mosquitoes were morphologically identified. Female Anopheles mosquitoes were classified according to their physiological status as unfed, fed, partially gravid and gravid, sorted and counted. Members of the A. gambiae complex were identified using a Polymerase chain reaction (PCR) method. Enzyme-linked-immunosorbent assay (ELISA) was used to determine blood meal sources and Plasmodium infection rates in A. gambiae s.l. mosquitoes. Blood meal tests were conducted on DNA extracted from gut contents of blood fed A. gambiae s.l. The head and thorax section of dried samples of A. gambiae s.l. were used in testing for the presence of Plasmodium falciparum (Pf) sporozoites. Overall, 735 adult femaleAnopheles comprising 708 [96.3%] A. gambiae s.l. and 27 [3.7%] Anopheles funestusmosquitoes were collected. A. gambiae s.l. population collected comprised, 615 [86.9%] unfed and 38 [5.4%] fed adult mosquitoes. The rest were either partially or fully gravid. The proportion of A. gambiae s.l. biting indoors within 18:00–21:00 h was 15.8% (103/653) at a rate of 3.2 bites per person per hour compared to 84.2% biting from 21:00-06:00 h at a rate of 3.8 bites/per/h. An estimated 97.7% A. gambiae ss and 2.3% A. arabiensis constituted the indoor biting A. gambiae s.l. The population of An. gambiae s.l. biting from 18:00 to 21:00 h had a Plasmodium faciparum (pf)
sporozoite rate of 3.8% compared to 3.5% observed in populations biting within 21:00-06:00 h. Human blood constituted 89% of An. gambiae s.l. blood meal sources. The risk of malaria transmission from 21:00 to 06:00 h was approximately 5 fold the risk within 18:00–21:00 h. Majority of the infective female A. gambiae s.l. adults were biting deep into the night than in the early hours of the night. Humans remain the preferred source of blood meal for A. gambiae s.s. the dominant malaria vector in the highlands. ITNs remain a fundamental control intervention against malaria transmission since female blood seekers were more during bed time than pre-bed time. Advocacy on enhanced net availability, integrity and usage in Kenyan highlands can reduce Pf transmission. Additional complementary interventions are required to control the biting and parasite transmission encountered before bed-time.

**Keywords:** Vector control; ITN; Anopheles gambiae; Mosquito biting time; Sporozoites