Abstract

Background: Malaria in the western Kenya highlands is characterized by unstable and high transmission variability which results in epidemics during periods of suitable climatic conditions. The sensitivity of a site to malaria epidemics depends on the level of immunity of the human population. This study examined how terrain in the highlands affects exposure and sensitivity of a site to malaria. Methods: The study was conducted in five sites in the western Kenya highlands, two U-shaped valleys (Iguhu, Emutete), two V-shaped valleys (Marani, Fort-Ternan) and one plateau (Shikondi) for 16 months among 6-15 years old children. Exposure to malaria was tested using circum-sporozoite protein (CSP) and merozoite surface protein (MSP) immunochromatographic antibody tests; malaria infections were tested by microscopic examination of thick and thin smears, the children's homes were georeferenced using a global positioning system. Paired t-test was used to compare the mean prevalence rates of the sites, K-function was use to determine if the clustering of malaria infections was significant. Results and Discussion: The mean antibody prevalence was 22.6% in Iguhu, 24% in Emutete, 11.5% in Shikondi, 8.3% in Fort-Ternan and 9.3% in Marani. The mean malaria infection prevalence was 23.3% in Iguhu, 21.9% in Emutete, 4.7% in Shikondi, 2.9% in Fort-Ternan and 2.4% in Marani. There was a significant difference in the antibodies and malaria infection prevalence between the two valley systems, and between the two valley systems and the plateau ($P < 0.05$). There was no significant difference in the antibodies and malaria infection prevalence in the two U-shaped valleys (Iguhu and Emutete) and in the V-shaped valleys (Marani and Fort Ternan) ($P > 0.05$). There was 8.5- fold and a 2-fold greater parasite and antibody prevalence respectively, in the U-shaped compared to the V-shaped valleys. The plateau antibody and parasite prevalence was similar to that of the V-shaped valleys. There was clustering of malaria antibodies and infections around flat areas in the U-shaped valleys, the infections were randomly distributed in the V-shaped valleys and less clustered at the plateau. Conclusion: This study showed that the V-shaped ecosystems have very low malaria prevalence and few individuals with an immune response to two major malaria antigens and they can be considered as epidemic hotspots. These populations are at higher risk of severe forms of malaria during hyper-transmission seasons. The plateau ecosystem has a similar infection and immune response to the V-shaped ecosystems. The U-shaped ecosystems are transmission hotspots.