

BACKGROUND:

Malaria vector control in Africa depends upon effective insecticides in bed nets and indoor residual sprays. This study investigated the extent of insecticide resistance in *Anopheles gambiae* s.l., *Anopheles gambiae* s.s. and *Anopheles arabiensis* in western Kenya where ownership of insecticide-treated bed nets has risen steadily from the late 1990s to 2010. Temporal and spatial variation in the frequency of a knock down resistance (kdr) allele in *A. gambiae* s.s. was quantified, as was variation in phenotypic resistance among geographic populations of *A. gambiae* s.l.

METHODS:

To investigate temporal variation in kdr frequency, individual specimens of *A. gambiae* s.s. from two sentinel sites were genotyped using RT-PCR from 1996-2010. Spatial variation in kdr frequency, species composition, and resistance status were investigated in additional populations of *A. gambiae* s.l. sampled in western Kenya in 2009 and 2010. Specimens were genotyped for kdr as above and identified to species via conventional PCR. Field-collected larvae were reared to adulthood and tested for insecticide resistance using WHO bioassays.

RESULTS:

Anopheles gambiae s.s. showed a dramatic increase in kdr frequency from 1996 - 2010, coincident with the scale up of insecticide-treated nets. By 2009-2010, the kdr L1014S allele was nearly fixed in the *A. gambiae* s.s. population, but was absent in *A. arabiensis*. Near Lake Victoria, *A. arabiensis* was dominant in samples, while at sites north of the lake *A. gambiae* s.s. was more common but declined relative to *A. arabiensis* from 2009 to 2010. Bioassays demonstrated that *A. gambiae* s.s. had moderate phenotypic levels of resistance to DDT, permethrin and deltamethrin while *A. arabiensis* was susceptible to all insecticides tested.

CONCLUSIONS:

The kdr L1014S allele has approached fixation in *A. gambiae* s.s. populations of western Kenya, and these same populations exhibit varying degrees of phenotypic resistance to DDT and

pyrethroid insecticides. The near absence of *A. gambiae* s.s. from populations along the lakeshore and the apparent decline in other populations suggest that insecticide-treated nets remain effective against this mosquito despite the increase in *kdr* allele frequency. The persistence of *A. arabiensis*, despite little or no detectable insecticide resistance, is likely due to behavioural traits such as outdoor feeding and/or feeding on non-human hosts by which this species avoids interaction with insecticide-treated nets.