

Wind tunnel studies on the effect of insecticide treated materials on *Ae. aegypti* host location behaviour

Abstract

Background Insecticide treated materials (ITMs), such as bed nets, curtains and doorway and window screens can reduce domestic infestations of *Ae. aegypti* and potentially impact dengue transmission. All ITMs depend on pyrethroids, but as shown elsewhere in this thesis, strong pyrethroid resistance exists in *Ae. aegypti* populations from Makkah and Jeddah. This chapter reports on investigations into the behaviour of host-seeking adult females of these resistant populations as they respond to a host behind an ITM barrier containing holes.

Methods Field-collected insecticide resistant mosquitoes from Jeddah and Makkah, and a fully susceptible New Orleans strain were released individually into a wind tunnel to fly upwind towards holed nets (untreated/PermaNet 2.0). The behavioural events (Flying, Resting, Bouncing, Visiting) were digitally recorded for 20 min and analysed.

Results In a wind tunnel bioassay, 100% of Makkah females, 87.5% of Jeddah and 60% of New Orleans (control susceptible strain) mosquitoes successfully passed through the holes in an untreated net within the 20 min trial period. There was a significant reduction in the number of mosquitoes that passed through the treated net compared to untreated net ($P < 0.0005$). This reduction was significantly greater for the New Orleans susceptible strain (85%) compared to the resistant strains, Jeddah (59%) and Makkah (42%) ($P < 0.01$). All New Orleans were knocked down by the end of the assay, Jeddah and Makkah were not knocked down but 90% and 45% mortality, respectively was recorded in the 24h post assay assessment. Analysis of specific behavioural events showed an increase in resting on the wind tunnel walls post contact with insecticide treated net and a reduction in bouncing and visiting the net, suggesting an impact of contact irritancy or a sub-lethal effect from deltamethrin.

Conclusion These data indicate that a PermaNet 2.0 net might fail to protect against the resistant Makkah and Jeddah mosquitoes. However, further behavioural studies are needed to understand mosquito behaviour to ITNs alongside other vector control interventions. Overall, this indicates that physiological resistance enabled resistant mosquitoes to pass through the holed treated nets better by surviving long enough to do so, rather than by changing behaviours with patterns either similar between strains or not varying in a manner consistent with resistance level.