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Insecticide resistance in malaria vectors in central Sudan

Abdalla, Hiba Mohammed Abu Bakr

2008-12-01T09:59:46Z
http://hdl.handle.net/10539/5854

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CHAPTER FIVE

GENERAL CONCLUSION

The present study has achieved its objectives in a) identifying the malaria vectors in central Sudan b) determine their susceptibility/resistance to the four common insecticide classes used in vector control and c) determining the *kdr* frequencies in susceptible/resistant specimens. It has also determined the sporozoite rate and the host blood meal sources in the populations studied.

Anopheles arabiensis was the only member of the *An. gambiae* complex present in the study area and was identified as the main malaria vector. Results showed that *An. arabiensis* is largely endophilic and anthropophilic with 89.2% fed on humans, which makes vector control using indoor residual spraying and ITNs effective in central Sudan.

This is the first detailed insecticide resistance study carried out in central Sudan for over 30 years. It is also the first report of pyrethroid resistance in Sudan and high frequencies of the *kdr* mutation in an *An. arabiensis* population. There was no strong correlation of the *kdr* mutation with resistant phenotypes to either the pyrethroid permethrin or the organochlorine DDT. Further, the lack of correlation between the presence of the Leu → Phe *kdr* mutation and the resistant phenotypes in these populations undermines the use of the two step PCR assay to determine susceptibility. Investigations into alternative mechanisms conferring pyrethroid and DDT resistance are urgently needed.

These findings have serious implications for the malaria control programmes in Gezira and Sennar states of central Sudan since they depend largely on the use of pyrethroid insecticides for indoor residual spraying and for insecticide-treated bed nets. At present only pyrethroids are used in the treating of bed nets. It is not known however, how this finding will affect the impact of ITNs since kill is not the only method of protection with this strategy. For indoor residual spraying, bendiocarb (carbamates) could be used as a possible alternative. Issues of cost and appropriate application by spray teams would have to be taken into consideration. Furthermore, the rotational use of insecticides should be part of a resistance management strategy. Finally, insecticide resistance studies should be carried out in other regions of Sudan to provide data necessary for the planning of countrywide malaria control, as well as during other times of the year to monitor variation in the vector populations. This last is ongoing research in the Gezira and Sennar regions.