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IMPACT OF DELTAMETHRIN-IMPREGNATED BEDNETS ON BITING RATES OF MOSQUITOES IN ZAIRE

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ABSTRACT. In a rural area of Zaire, the whole population of a village was protected by deltamethrin-impregnated mosquitoes bednets. A similar village was observed as a control. Biting rates for mosquitoes were recorded in both villages. The principal man-biting species were *Mansonia africana, Mansonia uniformis,* and *Aedes aegypti.* In the village protected by the impregnated mosquito bednets, the number of *Mansonia* bites was reduced 96% indoors and at a lesser rate outdoors. Biting rates of *Ae. aegypti* dropped to 0 indoors, but the outdoor biting rate remained unchanged. It is concluded that the reduction in mosquito bites is not only caused by the repellent action of the deltamethrin but also by a reduction in mosquito numbers.

INTRODUCTION

The use of insecticide-treated mosquito bednets for the control of malaria has generated much interest (Bermejo and Veeken 1992). Insecticide-impregnated bednets have been used successfully in several countries: China (Li Zuzi et al. 1989), Gambia (Lindsay and Adiamah 1992, Alonso et al. 1993) and Burkina Faso (Robert and Carnevale 1991), In a study in Zaire, this strategy resulted in a reduction in the number of bites from the malaria vector *Anopheles gambiae s.l.* by 94% (Karch et al. 1993). Parasite inoculation rates in the treated area were similarly reduced. Additionally, other pests such as bedbugs, ticks, and lice were controlled by the treatment (Lindsay et al. 1989).

In this paper we evaluate the effect of deltamethrin-impregnated mosquito bednets on the biting rates of the significant species *Mansonia africana* (Theobald), *Mansonia uniformis* (Theobald), and *Aedes aegypti* (Linn.)

MATERIALS AND METHODS

The 2 villages selected for this study were situated some 60 km east of Kinshasa on the Bateké plateau in Zaire. The distance between the 2 villages was 8 km. Houses in the 2 villages are clustered in widely dispersed compounds. Most houses consist of 2 rooms and have mud and stick walls. Approximately 50% of the houses have corrugated tin roofs.

During the first year (February 1990–January 1991), entomological baseline data were collected. Subsequently the village of Mbangu-mbamu was selected as the trial site for control of malaria using impregnated mosquito bednets. Mbangu-mbamu has some 3,000 inhabitants, many of whom share the same bed, particularly children and their mothers. Distribution of bednets was based on the number of beds in the village. Some 800 mosquito bednets impregnated with deltamethrin (K-Othrin®) at the rate of 25 mg/m^2 were issued. The number of houses in the village was 450.

The village of Mbansalé, with some 900 inhabitants and 135 houses, served as a control. It should be noted that the residents of both villages were protected against malaria attacks by the use of chloroquine and quinine made available at local health centers.

From February 1990 to November 1991, weekly collections were made in each village by a team of 6 collectors and a leader. The teams worked from 1700 to 0600 h, with 3 collectors in the same room as the treated mosquito bednet and 3 outside the house. The most abundant species were *Ma. africana, Ma. uniformis,* and *Ae. aegypti.* The daily biting of *Mansonia* species was calculated for the 1700–0600 h time period, whereas the *Aedes* rate was estimated from 1700 to 2100 h because its activity fell off at 2100 h. Distance from breeding sites to the village was 200 m for Mbangu-mbamu and 100 m for Mbansalé.

RESULTS

The effect of the mosquito bednet treatment on the 2 *Mansonia* species was similar. The biting rate for *Ma. africana* decreased from 11.5 per night to 0.4 in the room with the mosquito net, a reduction of 96.5%. Differences between the treated area and the control were significant ($\chi^2 = 5.73$, $P = 0.01$). No significant differences were noted for the outdoor biting rate ($\chi^2 = 1.33$). In the control village, both indoor and outdoor rates remained unchanged and similar to that of the pretreatment years (Fig. 1).

The indoor biting rate for *Ma. uniformis* decreased by 92% ($\chi^2 = 3.71$, $P = 0.05$). No sig-

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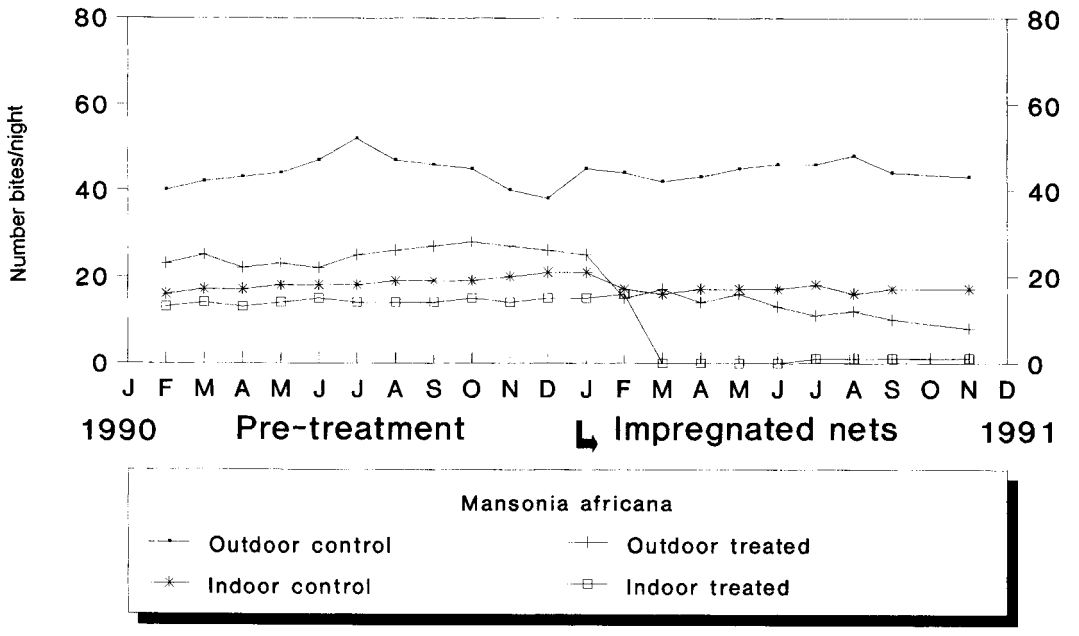

Fig. 1. Biting of *Mansonia africana* in 2 villages before and after treatment with impregnated bednets.

nificant differences were noted for the outdoor biting rate ($\chi^2 = 2.27$) in the protected area, and biting rates remained unchanged in the control (Fig. 2).

The indoor biting rate of *Ae. aegypti* was 0 (Fig. 3), but it should be pointed out that the biting rate was never very high. The outdoor biting rate remained unchanged. In the control area, the situation remained the same during the 2 years.

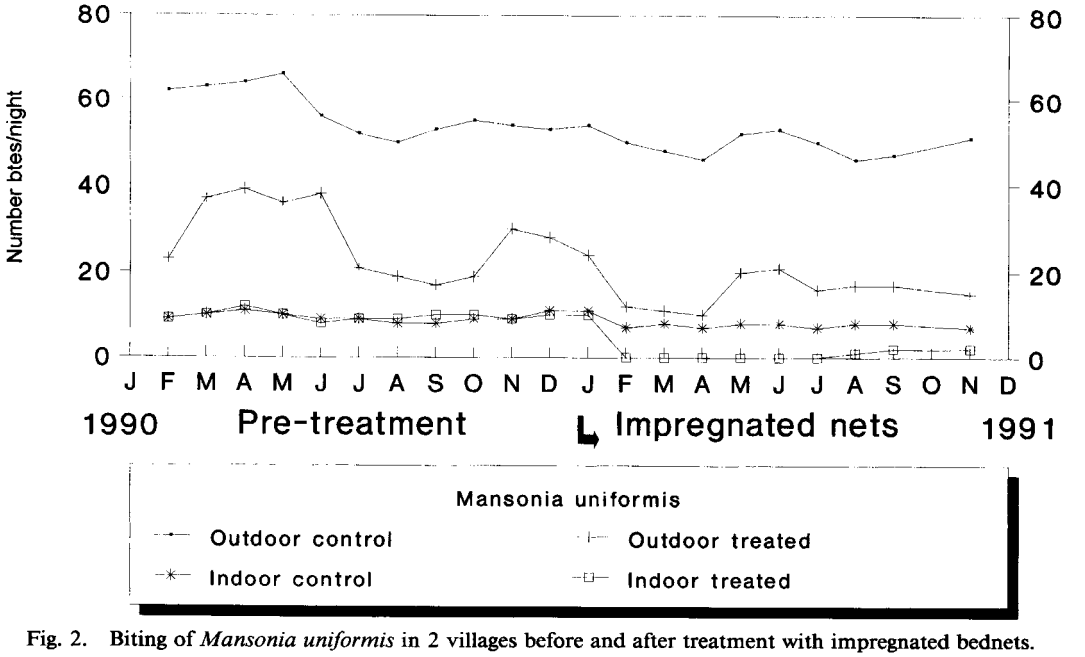

Fig. 2. Biting of *Mansonia uniformis* in 2 villages before and after treatment with impregnated bednets.

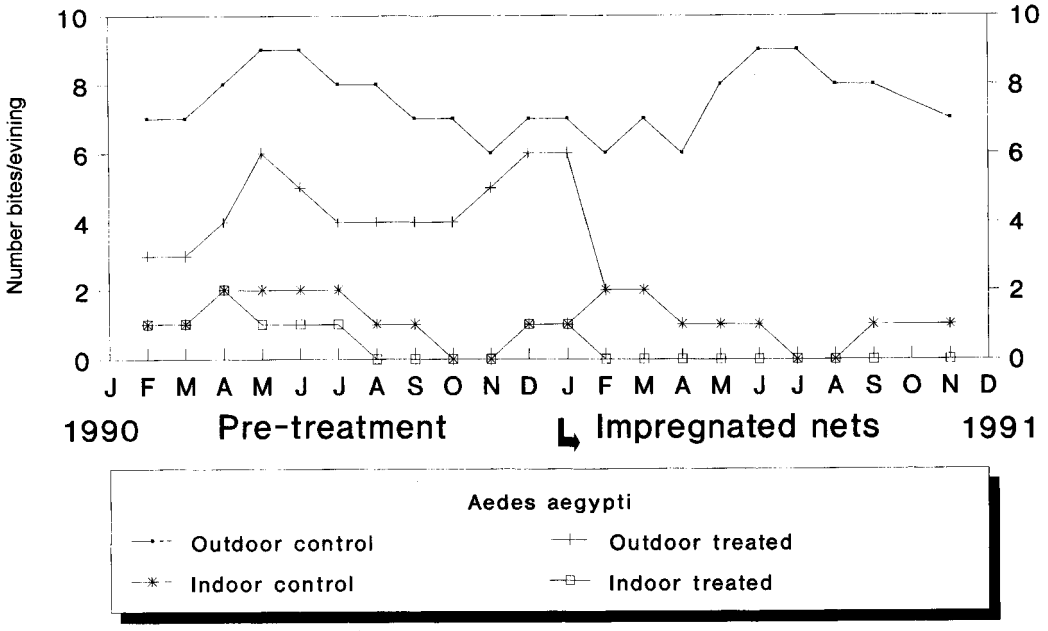

Fig. 3. Biting of *Aedes aegypti* in 2 villages before and after treatment with impregnated bednets.

DISCUSSION

Mosquitoes are a serious problem on the Bateké plateau. The average culicine biting rate is 91 per night, compared to 26 for anophelines. Under such conditions, the acceptance of treated mosquito bednets is important because it is an effective method of control. Both *Ma. africana* and *Ma. uniformis* are considered to be major pest species (Karch et al. 1992).

The reduction of *Mansonia* species inside houses was welcomed by the population as the bites of these mosquitoes are painful. This reduction could be caused by the repellent action of deltamethrin or a decrease in the numbers of mosquitoes. The decrease in outdoor biting rates supports the latter hypothesis. Such insect population reductions following the use of impregnated mosquito bednets by an entire community has been observed in China with *Anopheles sinensis* Wied. and *Anopheles anthropophagus* Xu & Feng (Li Zuzi et al. 1989). This effect was not anticipated for *Mansonia,* which are primarily outdoor biters.

The reduction to a 0 biting rate for *Ae. aegypti* is interesting, but we make no conclusions because the biting rate was already low. Further investigations in areas of high *Ae. aegypti* population densities should be carried out to determine the precise effect of deltamethrin. Outdoor biting rates of *Ae. aegypti* remained unchanged. This finding would support the hypothesis of a genetic segregation between the indoor and outdoor populations of *Ae. aegypti* observed in East Africa (Trpis et al. 1973).

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