Jungle Yellow Fever in Goiás, Brazil

Because of the occurrence of cases of jungle yellow fever in the central region of the State of Goiás, Brazil, in late 1979 and early 1980, the Evandro Chagas Institute, with the support of the Public Health Campaign Authority (SUCAM), carried out studies in a number of municipalities of the region affected in order to obtain ecological and epidemiological information about the problem.

The studies were made between 19 February and 5 March 1980. During that period new cases of yellow fever were reported.

Ecological Studies

Initially an area in the municipality of São João da Aliança, where the occurrence of human cases of yellow fever and deaths of monkeys had been confirmed, was selected for the ecological studies. However, since it was not possible to reach that area because of floods, two other areas in which some of the cases of yellow fever had probably contracted the infection, were selected. One of these is situated on the border of the municipalities of Uruaçú and Niquelândia and the other, in the municipality of Barro Alto, near Goianésia. In each of them, mosquitoes and jungle vertebrates were captured. The arthropods were captured during the day by means of human bait, and the vertebrates, through the use of wire traps, nets, or fire arms. Of the 8,678 mosquitoes captured, 512 belonged to the genus *Haemagogus* and included species known to be important vectors of the jungle yellow fever virus in South America. Of the 512 insects, 461 were *Haemagogus* sp. and 51, *Haemagogus leucocelaenus*. The number of *Haemagogus* captured per man/hour was 3.2 and a total of 60.6 mosquitoes were captured per man/hour. No *Haemagogus* was trapped in five hours of peridomiciliary capture.

The insects from Uruaçú and Niquelândia were inoculated, in the form of 354 pools, into the brain of suckling mice. Four isolations, all of yellow fever (YF) virus, were obtained from *Haemagogus* sp. (28 pools); this means that at least one of every 115 *Haemagogus* was infected.

Of the 4,529 arthropods captured on the ranches of Barro Alto, 1,031 belonged to the genus *Haemagogus*; the man/hour mosquito capture rate was 4.7 for *Haemagogus* and 28 for all mosquitoes. Only five *Haemagogus* were trapped in four hours of peridomiciliary capture. No isolation of the virus was obtained with the inoculation of the arthropods, in the form of 220 pools, into suckling mice brain.

In Uruaçú and Barro Alto 119 vertebrates were captured: 100 bats, seven primates, seven marsupials, and five rodents. The blood and visceral suspensions of these animals were inoculated into mice with negative results. The hemagglutination inhibition tests (HI) made with the sera of 62 animals gave positive results: three bats for Group B, one rodent (also positive for St. Louis encephalitis), one marsupial, and one primate, both positive for Group A.

Epidemiological Studies

Concurrently with the ecological studies, a serological study was made of the population of three municipalities in order to determine the prevalence of HI antibodies for YF virus and other flavovirus existing in Brazil, as well as the incidence of infections caused by the yellow fever virus. The survey included 662 persons from the municipalities of Uruaçú, Barro Alto, and Goianésia, most of whom were resident in rural areas. The specimens were obtained from persons who had been previously vaccinated or who had come to be vaccinated against yellow fever. The results, presented in Table 1, did not show any differences as regards sex, and positive reactors were found in all age groups; however, the highest rates occurred among older people. In Goianésia the prevalence

Table 1. Flavovirus[a] hemagglutination inhibition (HI) antibodies in residents of three municipalities of Goiás, February–March 1980.

Municipality	No. of persons surveyed	Persons with Ab			
		HI P/Flavovirus		HI ≥ 1:160 P/Yellow fever	
		No.	%	No.	%
Uruaçú	246	72	29.3	4 (1)[b]	1.6 (0.4)[c]
Barro Alto	270	72	26.7	1 (1)	0.4 (0.4)
Goianésia	106	36	34.0	0	0
Total	622	180	28.9	5	0.8

[a]Yellow fever (YF), Ilhéus, St. Louis encephalitis, Bussuquara, and Rocio.
[b]Individuals with CF antibodies ≥ 1:64.
[c]Estimated incidence of recent infections.

was slightly higher than in the other municipalities. Five (0.8 per cent) of the persons examined showed HI antibody titers equal to or higher than 1:160; four of them lived in Uruaçú and one in Barro Alto. Four were males and, with the exception of one aged 13 years, the others were 30 years of age or more. Two individuals (one from Uruaçú and the other from Barro Alto) had YF antibodies with titers of 1:64, which indicates that they had probably been recently infected and had developed a benign clinical form of the disease. Consequently, it is estimated that the incidence of the infection was 0.4 per cent in each one of the municipalities.

The results observed in the 622 sera examined by means of HI tests against antigens of various arboviruses in the region are summarized in Table 2.

No positive reactions were observed for eastern or western equine encephalitis, Bussuquara, Be An 327600 (Group B), Caraparu (Group C), Guama (Group Guama), Icoaracy (sandfly fever group), Araguari and Be An 280577 (not grouped).

The results of the investigation indicate that the sole vector infected with yellow fever virus belonged to the genus *Haemagogus*. The species could not be determined. Examination of females made identification possible only at the level of the genus. Attempts to obtain males—essential for determining the species—failed, since the females died before ovulating. It should be pointed out that other species involved in the transmission of YF virus in the Americas (*Haemagogus leucocelaenus* and *Subethes chloropterus*) were not found infected despite the fact that a large number of them were examined.

It should be emphasized that the infected *Haemagogus* sp. were those captured in the forests of Uruaçú-Niquelândia, even though in Barro Alto twice as many *Haemagogus* were captured. In some areas the *Haemagogus* capture rate was slightly higher in the canopy of the trees than at the soil level whereas, in others, the captures in trees were four times more productive. The fact that *Haemagogus* was found in a peridomiciliary environment, about 100 meters from the forest of Belmonte, in Barro Alto, confirms the possible transmission of YF outside the forest. This fact had already been observed in other areas of Goiás (Pinheiro, F. P. et al., 1980).

The absence of immunity to YF virus in primates was somewhat surprising; this phenomenon may be explained by the fact that only seven animals were examined (three from Uruaçú and four from Barro Alto).

Table 2. Results obtained in 622 sera examined by means of HI tests.

Group	Virus	Sera	%
A	Mayaro	60	9.6
	Mucambo	1	0.1
	Cross-reactions	6	0.9
California	Guaroa	2	0.3
Simbú	Oropouche	12	1.9
	Utinga	1	0.1
Anopheles A	Tacaiuma	1	0.1

The presence of flavovirus HI antibodies in about 30 per cent of the 622 persons examined is largely explained by yellow fever vaccination. Indeed, almost two thirds of the persons reported having been vaccinated with 17D vaccine a few weeks earlier.

If we accept the estimated incidence—0.4 per cent—of recent infections by YF virus in groups of persons examined in the rural areas of Uruaçú and Barro Alto and apply it to the entire rural population of the two municipalities (27,853 and 8,379 inhabitants, respectively), the probable number of recent cases would be 145 for the two municipalities.

The current outbreak of yellow fever in Goiás (20 cases as of 1 December 1980) confirms the cyclical character of the disease observed in the State for almost 40 years. But, unlike what happened in 1972-73, when the disease spread to the south of Goiás, Mato Grosso, and Paraguay (Pinheiro, F. P. et al., 1978), or in earlier periods, when other states of Brazil and Argentina were affected (Taylor, R. M., 1951), the current outbreak appears to be limited to the central region of Goiás. The wave may possibly have stopped spontaneously, but it is more likely to have been arrested by the energetic vaccination campaign immediately undertaken in the area as soon as the outbreak was discovered. The cyclical occurrence of yellow fever in certain areas of Goiás has been attributed to periodic incursions of the virus from the Amazon region (Kerr, J. A., 1951, and Aitken, T. et al.). However, this hypothesis should be reevaluated and the possibility of the persistence of the virus at a low enzootic level, and even the transovaric transmission of the virus in *Haemagogus*. should be investigated.

(*Source: Boletim Epidemiológico*. XII (10), 1980. Ministry of Health of Brazil.)