RESEARCH NOTE

Living and Avoiding Malaria Infection in Endemic Areas of the Amazon Basin

Helena Cristina Balthazar-Guedes, Maria de Fátima Ferreira-da-Cruz, Claudio Tadeu Daniel-Ribeiro+

Departamento de Imunologia, Instituto Oswaldo Cruz, Av. Brasil 4365, 21045-900 Rio de Janeiro, RJ, Brasil

Key words: malaria - epidemiology

The increase in the number of malaria cases in the Amazon basin, during the period of 1970 to 1980, was a result of the Brazilian government promotion of land occupation, by small and medium size farms. The resulting disorganized emigration of a million persons into malaria endemic regions (AC Marques 1987 *Parasitol Today 3:* 166-170) was also stimulated by mining of minerals and road and hydroelectric plant construction (LM Deane 1988 *Am J Trop Med Hyg 38:* 223-230). The vast majority of migrants were non-immune individuals that came from non-endemic regions of the country. The migrants were concentrated mainly in the State of Rondônia (Western Amazon Region) that, in 1991, accounted for 33% of all reported malaria cases in Brazil (Weekly Epidemiological Records 1992 *WHO 22:* 161-168). According to the Brazilian Ministry of Health, malaria is endemic in this locality, and there was no marked seasonal variation in malaria incidence during the studied period.

A total of 439 inhabitants of Ariquemes municipality, State of Rondônia, were provided with a questionnaire, where personal and epidemiological data were collected. Blood samples were obtained from symptomatic individuals that reported to the local National Health Foundation (FNS) outpatient clinic with suspected malaria and, therefore, looking for diagnosis. A description of population demographics has been reported elsewhere (J Oliveira-Ferreira et al. 1992 *Am J Trop Med Hyg 46:* 720-726). Thick and thin blood smears were prepared and examined for the presence of malaria parasites by the authors and FNS team (thick smear only), concomitantly. Volunteers were grouped according to malaria diagnosis by thick blood smear and the date of the last malaria attack, as follows: group A: symptomatic individuals with positive thick blood smear (87); group B: individuals with negative thick blood smear and last malaria attack ≤ 30 days (91); group C: individuals with negative thick blood smear and last malaria attack occurring from 30 to 180 days before blood collection (89); group D: individuals with negative thick blood smear and last malaria attack from 180 to 360 days (79) and; group E: individuals with negative thick blood smear and last malaria attack > 360 days (93).

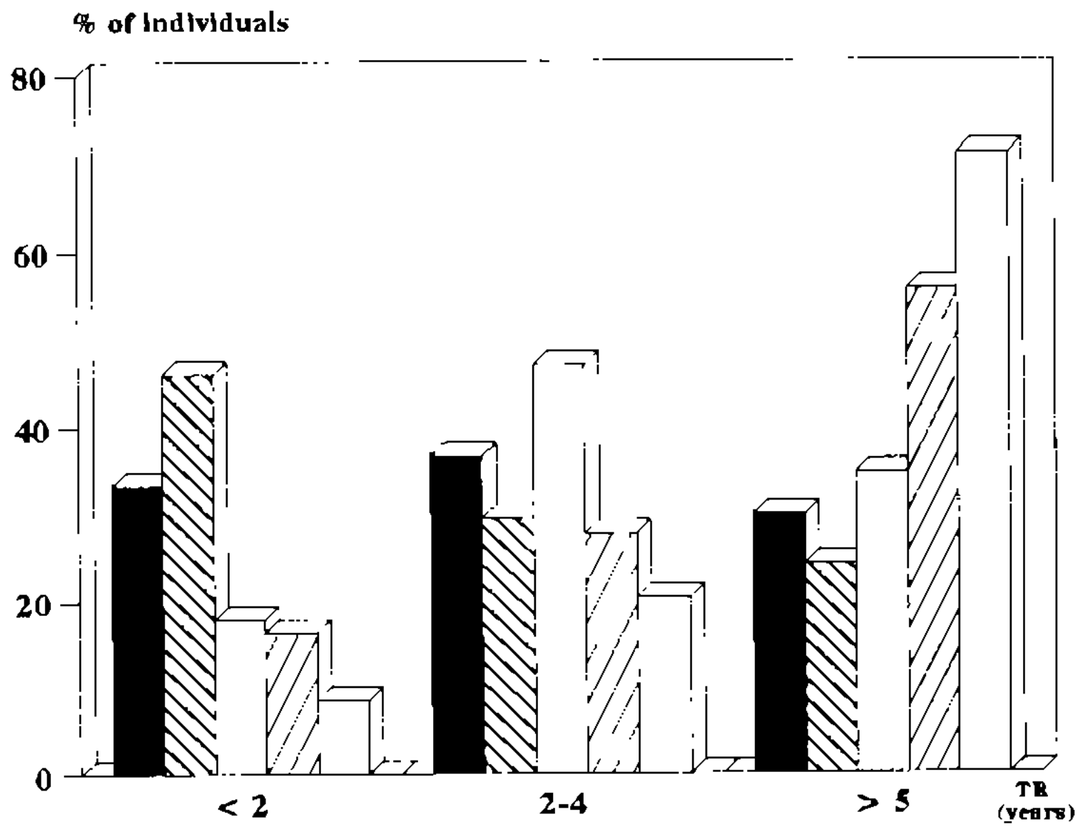
The population studied was young (67.2% under 30 years of age), evenly distributed according to sex (57% male and 43% female). The greater part of individuals (67.8%) had lived in this region for about five years. Malaria infection rates were similar for both males (11.4%) and females (8.4%). A total of 43% of tested individuals examined reported only one previous malaria attack. Although the remaining 57% reported more than one malaria attack, only 25.6% reported more than ten malaria attacks. The mean number of past malaria episodes was similar among the groups (A = 8, B = 7, C = 8, D = 7, E = 6). It must be emphasized that since individuals in this study were not hospitalized and 68% of those from group A had the last malaria attack less than thirty days before examination; we can not exclude the possibility that some of these infections are a result of drug resistance or incomplete drug treatment. No correlation was observed between age and positive thick blood smear or the number of malaria attacks (data not shown). Since in a migrant population, age does not reflect the time of exposure to malaria infection, we hypothesized that the time of residence would be positively correlated with the number of malaria attacks, but this was not the case, as already observed in the same area (Oliveira-Ferreira et al. *loc. cit.*). Furthermore, the majority of individuals with positive thick blood smears or recently infected (groups A and B) had lived in the study area for less than two years. Inversely, the major portion of individuals studied more than one year after the last malaria attack (group E) had lived in the region for more than five years (Fig.).

According to the results of this and previous sero-epidemiological studies conducted in the same area (Oliveira-Ferreira et al. *loc. cit.*), the greater part of the population was composed of individuals that most likely did not have enough

This work is part of the thesis of the first author.

+ Corresponding author

Received 8 October 1993
Accepted 22 July 1994



Distribution of sampled population according to the time elapsed after last malaria attack and to the time of residence in a malaria endemic region (Ariquemes municipality, State of Rondônia, Brazil).
■: individuals with positive thick blood smear; ▨: negative thick blood smear and last malaria attack ≤ 30 days; ▩: negative thick blood smear and last malaria attack > 30 - ≤ 180 days; ▨: negative thick blood smear and last malaria attack >180 - ≤ 360 days; □: negative thick blood smear and last malaria attack > 360 days.

time to acquire protective immunity against malaria. In fact, the acquisition of protective immunity to malaria is considered to be a slow process that requires longstanding contact with the parasite and maintenance of a constant antigenic stimulus. Previous epidemiological studies have shown that the frequency of antibodies against *P. falciparum* antigens increases with the time of exposure to malaria infection, even in regions with moderate transmission rates (P Kamol-Ratanakul et al. 1992 *Am J Trop Med Hyg 47:* 554-561, P Deloron & M Cot 1990 *Trans R Soc Trop Med Hyg 84:* 191-195, P Deloron et al. 1989 *Am J Trop Med Hyg 41:* 395-399, C Chizzolini et al. 1988 *Am J Trop Med Hyg 39:* 150-156). The present study did not take into account the possibility of an immune population. Therefore, one possible explanation for low malaria transmission rates for individuals residing for a greater time in this region could be that, after being submitted to several malaria infections during their period of residence in the region, they underwent a learning process that helped them avoiding the disease. As a result of this process the knowledge of the symptoms and the search for early diagnosis and treatment of malaria, the improvement of living conditions, the stability of human settlements, as well as the use of individual prophylactic measures by the settlers, represent an aid to reduce the number of malaria attacks. These data suggest that the cultural process itself besides the improved diagnosis and rapid treatment by FNS have to be considered if we intend to develop a successful malaria control program. Therefore, conducting studies concerning social and economic behaviors and chemoprophylactic measures is required to define malaria risks based on social-economic patterns of migrants. These studies would provide information defining strategies and methodologies to reduce malaria transmission.

Acknowledgments: to Drs Romeu Rodrigues Fialho and Sandra Ferraciolli, Fundação Nacional de Saúde for logistical support during the field studies.