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AGRADECIMENTOS

Os autores agradecem ao Sr. Norman Patrick Foster, ex-gerente da Fazenda Três Barras pela cessão dos dados. À Senhorita Libertad Maria Nali, pelos serviços de cálculo e programação. A FAPESP, CNPq e OEA pelo apoio financeiro.

CONCENTRATIONS OF HAEMOGLOBINS A₂ AND FETAL IN BRAZILIAN INDIANS. RELATIONSHIP BETWEEN THESE HAEMOGLOBINS AND MALARIA¹

Recebido para publicação em 23/11/1977

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ABSTRACT. The concentrations of haemoglobins A₂ and Fetal were determined in 39 Brazilian Indians who had malaria infection caused by *P. vivax* and *P. falciparum*. The haemoglobin A₂ values ranged from 1.6 to 5.0% with a mean of 2.78% (S.D. 0.68%), and Fetal haemoglobin values

1. Trabalho realizado com auxílio do Conselho Nacional do Desenvolvimento Científico e Tecnológico, CNPq.

ranged from 0.10 to 0.75% with a mean of 0.29% (S.D. 0.17%); in 41 normal healthy persons without malaria, the range of haemoglobin A₂ was 2.1 to 3.8% with a mean of 2.84% (S.D. 0.88%) and the range of Fetal haemoglobin was 0.19 to 0.51% with a mean of 0.35% (S.D. 0.09). Therefore, no significant difference of both haemoglobins was found between the studied groups ($\alpha = 5\%$).

RESUMO. *Concentrações de hemoglobinas A₂ e fetal em índios brasileiros. Relação entre estas hemoglobinas e malária.* As concentrações de hemoglobinas A₂ e Fetal foram determinadas em 39 índios brasileiros portadores de malária causada por *P. vivax* e *P. falciparum*. Os valores de hemoglobina A₂ variaram de 1.6 a 5.0% com média de 2.77% (S.D. 0.68%), e os valores de hemoglobina Fetal variaram de 0.10 a 0.75% com média de 0.29% (S.D. 0.17%); em 41 indivíduos normais sem malária, o nível de hemoglobina A₂ foi de 2.1 a 3.8% com média de 2.84% (S.D. 0.88%) e o nível de hemoglobina Fetal foi de 0.19 a 0.51% com média de 0.35% (S.D. 0.09%). Portanto, não foram encontradas diferenças significativas dos níveis de hemoglobinas A₂ e Fetal entre os grupos estudados ($\alpha = 5\%$).

INTRODUCTION

The relationship between patients with malaria and haemoglobin A₂ has been reported in different populations. The increase of this haemoglobin in patients with malaria caused by *Plasmodium vivax* and *Plasmodium falciparum* was first suspected by Arends (1967) and confirmed by Lie-Injo *et al.* (1971). However, other authors showed that the co-existence of malaria infection does not seem to raise the level of haemoglobin A₂ (Weatherall *et al.*, 1971; Easan *et al.*, 1973).

There still exist several human populations in Brazil that are or have been submitted to the deleterious effect of malaria. Among these populations there are Indians communities that, because of their isolation, have not received complete sanitary benefits. For this reason, the study of the concentration of haemoglobin A₂ and Fetal among them has been considered of great interest in order to obtain additional information on the relationship between these haemoglobins and malaria.

MATERIAL AND METHODS

The Brazilian Indians studied are relatively acculturated, and the miscigenation with other races does not have occurred. They belong to the Iualapiti, Camaiurá, Mainaco, Uaurá, Cuicuro and Calapalo tribes and all live at Parque Nacional do Xingu, northeast of Mato Grosso state, between lat. 9° and 12° S, and long. 52° and 54° W. These people suffer of malaria during all their life with two crises during a year caused by *P. vivax* and *P. falciparum*.

The Indians group consisted of 39 subjects, all male and adults (from 16-60 years of age), and clinically well. The control group consisted of 41 normal healthy caucasian, without malaria, from laboratory personnel and medical students of the Faculdade de Medicina de Botucatu, all male and adults (from 22-54 years of age).

From each individual we obtained 5ml of blood in dried ethylenediaminetetracetic acid (EDTA) disodium salt for haemoglobin analysis; also 8 to 10ml of blood were clotted to obtain serum for es-

timination of serum iron. At the same time, thick and thin blood smears prepared for study of malaria parasites were Giemsa stained. The concentrations of serum iron were measured by the method of Hamilton *et al.* (1950).

The red cell haemolysates were prepared by the method of Drabkin (1946) and then adjusted to a final concentration of 10g/100ml. Haemoglobin A₂ levels in red cell were estimated by the cellulose acetate electrophoretic method described by Marenco-Rowe (1965) and expressed as the percentage of total haemoglobin. Fetal haemoglobin determinations were estimated by the method of Betke *et al.* (1966).

RESULTS AND DISCUSSION

Out of 39 subjects from the Indians group, 28 had *P. vivax*, 10 had *P. falciparum* and one had mixed infection.

The mean haemoglobin A₂ concentration of 2.77% in the Indians group did not differ significantly from the mean of the control group of 2.84% ($t=0.423$ $\alpha = 5\%$; see Table I). The same occurs with haemoglobin Fetal where the mean value in the group of Indians, 0.29%, did not differ significantly from the mean the control of 0.35% ($t=1.960$ $\alpha = 5\%$; see Table II). Serum iron concentrations were normal in both studied groups.

In respect to the relationship between malaria and haemoglobin A₂ level, contradictory results have

TABLE I — Comparison of haemoglobin A₂ levels in Brazilian Indians and control groups.

Data	Indians group	control group
Number tested	39	41
Range (%)	1.6 — 5.0	2.1 — 3.8
Mean (%)	2.77	2.84
SD (%)	0.68	0.88

significance of difference $t = 0.423$ $\alpha = 5\%$

TABLE II — Comparison of haemoglobin Fetal levels in Brazilian Indians and control groups.

Data	Indians group	control group
Number tested	39	41
Range (%)	0.10 — 0.75	0.19 — 0.51
Mean (%)	0.29	0.35
SD(%)	0.17	0.09

significance of difference $t = 1.960 \alpha = 5\%$

been obtained. Arends (1967) first noticed increased levels of this haemoglobin in eight patients with *P. vivax* malaria; however, there were no data on the iron status of the subjects studied. Arends (1971) postulated that the increase of haemoglobin A₂ in patients with acute, chronic and induced malaria was due to two mechanisms: (1) the increase of haemoglobin A₂ could possibly indicate a more generalized body reaction against malaria, including systems other than the immunologic system (in this case haemoglobin synthesis) and (2) the malaria parasite could have a selective preference for cells with a lower amount of haemoglobin A₂. Lie-Injo *et al.* (1971) noticed that the mean haemoglobin A₂ in 27 patients with *P. falciparum* malaria and 15 with *P. vivax* malaria differed significantly from the mean value in the normal ones. These data were collected where beta thalassaemia is prevalent (Lie-Injo, 1959) and the mean of haemoglobin A₂ in the malaria group was raised because of six patients with high values overlapping those of beta thalassaemia heterozygotes.

The absence of high concentrations of haemoglobin A₂ in patients with malaria infection was related by Weatherall *et al.* (1971) and Easi *et al.* (1973). However, in both studied populations there is prevalence of serum iron deficiency (Arends, 1974).

The studied population from Parque Nacional do Xingu suffers of malaria caused by *P. vivax* and *P. falciparum* after the age of six months, when the

haemoglobins A₂ and Fetal are stabilized. As this population doesn't have serum iron deficiency, which may lower the level of haemoglobin A₂ below normal, we believe that due to production of red cells and haemoglobin molecules that are quite adapted to malaria infection, the levels of haemoglobins A₂ and Fetal stay normal.

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EFEITOS DA HIPERVITAMINOSE A NA GLÂNDULA LACRIMAL EXTRA-ORBITÁRIA DO RATO. ESTUDO MORFOLÓGICO E MORFOMÉTRICO

Recebido para publicação em 25/11/1977

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ABSTRACT. *Effect of hypervitaminosis A on rat extra-orbital lachrymal gland. Morphologic and morphometric study.* Daily administration of 100 I.U vitamin A/gram of rat body weight, during 15 days, led the authors to observe: