Invest Clin 38(4): 191-201, 1997

Prevalence of anemia, iron, folic acid and vitamin B_{12} deficiency in two Bari indian communities from western Venezuela.

Maria Diez-Ewald[1], *Enrique Torres-Guerra*[1], *Miguel Layrisse*[2], *Irene Leets*[2], *Gilberto Vizcaino*[1] *y Melvis Arteaga-Vizcaino*[1].

[1]Instituto de Investigaciones Clinicas. Facultad de Medicina. Universidad del Zulia, Maracaibo e [2]Instituto Venezolano de Investigaciones Cientificas, Caracas. Venezuela.

Key words: Anemia, iron deficiency, folic acid deficiency, vitamin B_{12} deficiency.

Abstract. The hematological status of 406 Bari indians from two communities was studied.One hundred and seventy nine individuals were from Campo Rosario a village located in a low arid plain south to the Perijá mountain range and 287 were from Saimadoyi, a fertile valley in the heart of the mountain. Anemia was found in 54% and 31% of the people from Campo Rosario and Saimadoyi respectively. Low serum iron was present in 28% of the population in both communities while low serum ferritin levels were encountered in 20% of the population from Campo Rosario and 5% of the people from Saimadoyi. A high prevalence of serum folate and vitamin B_{12} deficiency (91% and 64% respectively) was found in Campo Rosario, in contrast only 5% of the population from Saimadoyi had low folate and none were vitamin B_{12} deficient. While there was a positive significant correlation between hemoglobin and serum iron concentrations ($r= 0.517$, $p<0.001$), no significative correlation was found between the other parameters studied. The high prevalence of anemia and nutrient deficiency among the Bari indians, can be atributed to inadequate diets and the varied diseases encountered in the population.

Prevalencia de anemia y deficiencia de hierro, ácido fólico y vitamina B_{12} en dos comunidades Bari del oeste de Venezuela.
Invest Clín 38(4): 191-201, 1997.

Palabras clave: Anemia, deficiencia de hierro, deficiencia de ácido fólico, deficiencia de vitamina B_{12}.

Resumen. Se estudia el estado hematológico de 406 indios Bari. Ciento setenta y nueve individuos pobladores de la comunidad de Campo Rosario, una árida llanura situada al sur de la sierra de Perijá y 287 habitantes de Saimadoyi, un fértil valle en el corazón de la montaña. El 54% de los pobladores de Campo Rosario y el 31% de los de Saimadoyi presentaron anemia y 28% de los habitantes de ambas comunidades presentó déficit de hierro sérico, mientras que sólo el 20% de los indígenas de Campo Rosario y 5% de los de Saimadoyi, tenían niveles bajos de ferritina. La prevalencia de deficiencia de folato y vitamina B_{12} fue excesivamente alta en Campo Rosario (91% y 64% respectivamente), mientras que en Saimadoyi sólo el 5% de los pobladores tenía folato bajo y ninguno tenía déficit de B_{12}. Sólo se halló correlación significativa entre la hemoglobina y el hierro sérico. La alta prevalencia de anemia y déficit de nutrientes, son atribuibles a la precaria dieta de estas poblaciones, especialmente Campo Rosario y a la presencia de infecciones, especialmente de piel y parasitarias.

Recibido: 4-3-97. Aceptado: 15-7-97.

INTRODUCTION

Nutritional anemia is one of the most common health problems in developing countries. Venezuela, during the last decade, has endured a severe economic crisis that has affected the whole population and especially those from the labor and marginal strata. The indian populations in the country are among the most vulnerable groups to nutritional deficiencies, especially those that live in secluded enviroments with little access to governamental health programs.

The purpose of the present work, is to study the frequency of anemia and nutrient deficiencies in two Barí indian populations from western Venezuela. The Barís are an ethnic group probably descendent from the pre-colombian Chibcha civilization, that is considered an endangered indian tribe. According to the last venezuelan population census (1), the venezuelan Barís are represented by 1503 individuals. Until 1960 these indians lived isolated in southwest Zulia State, near the venezuelan-colombian border in the Perijá mountain range. They were known for their ferociousness and frequent deadly assaults on farms and oil company settlements. In 1960 the so-called "pacification of

the motilones" was started by Catholic missionaries, and today they are a peaceful tribe that, although there is some communication with the rest of the country, they still live rather isolated, with their original customs almost intact.

MATERIALS AND METHODS

In this work two Bari communities were studied, Campo Rosario and Saimadoyi. In Campo Rosario, 179 individuals aged from 9 months to 69 years were studied. This community is situated in an arid area, with impoverished agriculture potential, in the foothills of the Perijá mountains, next to an oil company station. Families make their living from the wages earned by able males in the nearby cattle ranches. Their main diet consists of pasta or rice cooked with onions and sweet peppers and yuca (manioc). Vegetables and fruits are very scarce, as are animal products. They infrequently eat smoked monkey, the main animal protein source being the ocassional ingestion of canned sardines.

In the community of Saimadoyi, the population studied consisted of 287 individuals from 1 to 65 years of age. These live in a small fertile valley in the mountains with accesible vegetables and fruits, domestic animals, such as poultry and pigs,and adequate conditions for fishing and hunting.

In all individuals from both communities, blood samples were drawn from the antecubital vein. Blood extractions were started at 8 am and continued until 5 pm, therefore, many of the samples were not taken under fasting conditions. Part of the blood was delivered to a glass tube containing etilendiamine-tetraacetic acid (EDTA) for the determination of hemoglobin and the preparation of peripheral blood smears. The rest was placed in iron free glass tubes in order to obtain serum for the study of iron, ferritin, folic acid and vitamin B_{12}. There was not spare serum to test iron binding capacity. Serum aliquots were kept frozen at -20°C until processed. Hemoglobin was measured by the cyanometahemoglobin method of Crosby *et al* (2), serum iron was determined according to Caraway (3), ferritin by an immunoenzymatic absorbent method (ELISA) (4) and folic acid and vitamin B_{12} by a radioimmunoassay kit (General Diagnostic Products).

The sera from 70 samples of Campo Rosario, were analyzed for antibodies against *Helicobacter pylori* using the Pilo riset EIA G kit-orion.

The populations were divided in groups according to their ages: less than 4 years, 4 to 11 years, 12 to 17 years and more than 18 years. Starting from the age of 12 years, the groups were also subdivided according to sex. Lower normal values for hemoglobin in children under 2 years of age, were considered to be 10.7 g/dL. From 3 to 5 years, the cut off value was 10.9 g/dL (5) and from 6 to 11 years of age, 11.5 g/dL (6). The minimal normal values of

TABLE I

HEMATOLOGIC VALUES IN THE INDIAN COMMUNITY OF CAMPO ROSARIO

Age Years	Hemoglobin g/dL	Low Values %	Serum Iron µg/dl	Low Values %	Serum Ferritin µg/dl	Low Values %	Serum Folate µg/dl	Low Values %	Serum Vit. B12 mµg/dl	Low Values %
< 4	10.3 ± 2.3 (25)	52.0	46 ± 22 (10)	20.0	18 ± 11 (14)	14.0	0.6 ± 0.7 (4)	100.0	127 ± 39 (4)	75.0
4 - 11	10.1 ± 1.0 (47)	63.8	61 ± 28 (33)	30.3	22 ± 14 (38)	21.0	1.8 ± 1.4 (23)	87.0	169 ± 114 (23)	52.2
12 - 17										
Females	11.7 ± 1.4 (14)	50.0	72 ± 32 (14)	42.9	22 ± 16 (13)	38.5	0.8 ± 0.5 (6)	100.0	186 ± 147 (9)	66.6
Males	12.2 ± 1.4 (10)	40.0	73 ± 34 (10)	30.0	28 ± 19 (10)	22.2	1.1 ± 1.0 (10)	90.0	110 ± 98 (9)	88.8
≥ 18										
Females	11.0 ± 1.6 (42)	66.6	65 ± 30 (36)	43.0	24 ± 19 (41)	15.0	1.4 ± 1.0 (28)	89.2	229 ± 146 (30)	56.6
Males	13.1 ± 1.4 (43)	32.5	86 ± 29 (40)	7.5	38 ± 28 (43)	14.6	1.0 ± 1.0 (26)	96.4	172 ± 130 (28)	72.4
Total	11.8 ± 1.0 (179)	53.6	71 ± 9 (142)	27.5	28 ± 9 (157)	20.3	1.3 ± 0.7 (100)	91.0	172 ± 41 (104)	64.4

( ) Number of cases.

hemoglobin for people 12 years old and up were considered to be 12 g/dL for females and 13 g/dL for males (7). Lower normal values for serum iron were established at 30 μg/dL for children under 6 years of age (5), and 50 μg/dL for the rest of the population. Normal lower values of serum ferritin were considered to be 10 μg/L for children under 6 years of age and 12 μg/L for the population over this age, while values over 50 μg/L were considered as suggestive of the existence of inflammatory processes. The cut off value for folic acid was 3 μg/L and for vitamin B_{12} 150 mμg/L.

The statistical analysis consisted of the calculation of probability by Student's t test and the correlation index between the parameters studied.

RESULTS

The study of the peripheral blood smears from Campo Rosario showed mainly anisocytosis and hypochromia,with a mean diameter for red cells of 7.9 ± 0.36 μ. Most of the smears from Saimadoyi showed normocytic red cells, some of them with mild hypochromia, with a mean diameter of 7.4 ± 0.67 μ. Eosinophilia was present in most of the smears. Mean concentration of haemoglobin, as well as concentrations of the parameters defining nutrient deficiencies that affect hemoglobin concentrations of the subjects, according to age and sex, are shown in Tables I and II. When iron deficiency is defined as low concentration of serum ferritin, the results in Campo Rosario showed that only 14% of children below 4 years of age were deficient. This increased to 21% in the group from 4 to 11 years of age and reached the highest frequency in female adolescents (38.5%). Deficiency in adults was 15% in females and 14.6% in males, with a total prevalence of 20.3%. In all these groups, the frequency of anemia was higher than serum iron or ferritin deficiencies. Ferritin was only above 50 g/L in 2.6% of children between 4 and 11 years of age, in 12.1% of adult females and in 20.9% of adult males (Table III).

In the Saimadoyi community the total prevalence of ferritin deficiency was 5%. All the children under 4 years of age had normal levels of this parameter, 6.3% of those between 4 and 11 years were deficient, while the adolescents had a deficiency of 4.5% and 5% in females and males respectively. The female adult subgroup showed the highest iron deficiency at 9%. Only 3% of the male adults were deficient. In this community the prevalences of anemia and serum iron deficiency were significantly higher than that of serum ferritin deficiency, however the prevalence of elevated ferritin levels varied from 10% in adolescent males to 43.1% in adult males (Table III).

Serum folate values were below 3 μg/L in 91% of the population of Campo Rosario and below 1 μg/L in 56%. On the contrary, serum folate deficiency was only present in 3 adults from Saimadoyi.

TABLE II

HEMATOLOGIC VALUES IN THE INDIAN COMMUNITY OF SAIMADOYI

Age Years	Hemoglobin g/dL	Low Values %	Serum Iron µg/dl	Low Values %	Serum Ferritin µg/dl	Low Values %	Serum Folate µg/dl	Low Values %	Serum Vit. B12 mµg/dl	Low Values %
< 4	10.6 ± 1.2 (17)	64.7	52 ± 23 (11)	18.0	40 ± 28 (10)	0.0	5.7 ± 3.7 (5)	0.0	629 ± 681 (5)	0.0
4 - 11	11.3 ± 1.0 (91)	24.3	51 ± 17 (49)	49.0	33 ± 22 (79)	6.3	6.0 ± 2.8 (27)	0.0	566 ± 305 (27)	0.0
12 - 17										
Females	11.8 ± 1.2 (21)	57.1	67 ± 22 (16)	25.0	41 ± 26 (22)	4.5	5.6 ± 2.3 (5)	0.0	331 ± 589 (5)	0.0
Males	12.8 ± 1.1 (25)	60.0	76 ± 31 (20)	20.0	35 ± 18 (20)	5.0	3.9 ± 0.5 (4)	0.0	586 ± 247 (4)	0.0
≥ 18										
Females	12.0 ± 1.3 (57)	47.4	62 ± 26 (36)	25.0	41 ± 30 (45)	9.0	5.4 ± 2.0 (27)	3.0	706 ± 284 (27)	0.0
Males	13.4 ± 1.5 (76)	27.6	80 ± 32 (52)	15.3	54 ± 32 (65)	3.0	5.5 ± 4.2 (30)	13.3	648 ± 246 (30)	0.0
Total	12.2 ± 0.9 (287)	30.6	68 ± 12 (184)	27.7	44 ± 10 (241)	5.0	5.7 ± 1.0 (98)	5.1	621 ± 173 (98)	0.0

( ) Number of cases.

TABLA III
PREVALENCE OF HIGH SERUM FERRITIN VALUES IN THE POPULATIONS OF CAMPO ROSARIO AND SAIMADOYI

Age Years	Campo Rosario Ferritin > 50 µ/L (%)	Saimadoyi Ferritin > 50 µ/L (%)
< 4	0.0	20.0
4 - 11	2.6	20.3
12 - 17		
Males	0.0	22.7
Females	0.0	10.0
> 18		
Males	12.1	26.6
Females	20.9	43.1

Regarding vitamin B_{12} deficiency, the prevalence in Campo Rosario was 64% with a range of 52% in children from the 4 to 11 years subgroup to 89% in adolescent males. No vitamin B_{12} deficiency was found in Saimadoyi.

The results of the analysis of antibodies against the *Helicobacter pylori* showed that 93% of the samples were positive and there was not positive relationship between the vitamin B_{12} concentration in the serum and the antibodies titres.

The only significative correlation between the parameters studied was between hemoglobin and serum iron concentrations ($r = 0.517$, $p < 0.001$).

It is important to note that, in both populations studied, there was a high prevalence of skin infections, mainly scabiosis and secundary piogenic complications. According to Chacín-Bonilla and Sánchez-Chávez (8), 76.1% of the population from Campo Rosario and 92% of the individuals from Saimadoyi were affected by intestinal parasites, mainly *Ascaris lumbricoides* (36.1%), *Trichuris trichura* (29.2%), *Ancylostomidae* (18.7%), *Giardia lamblia* (13.8%) and *Entamoeba histolytica* (12.7%). More than one species of parasites were found in 67.9% of the population.

DISCUSSION

There have been few hematological studies on the south american aborigenes. In Venezuela, only three studies have been reported. Pons *et al* (9) in a multidisciplinary study of the "motilones" or Bari, reported a prevalence of 50% of anemia in the general population. Only hemoglobin and hematocrit were de-

termined. Wilbert *et al* (10) reported hematological studies made among the Warao indians living in the Orinoco Delta. They showed that 60% of children between 7 and 14 years of age and 57% of women of child bearing age had anaemia. In four out of seven children, and six out of fifteen women, the folate concentration was below 3 μg/L, and none of the children or women had low B_{12} concentrations.

The biological studies of indians living in Latin American countries have been mainly devoted to the genetic variations of alleles of blood groups and other genetic indicators. A survey of the literature regarding hematological findings, between 1970 and 1993, only mentions the studies performed by Franco *et al* (11) among the Mapuche indians in Southern Chile. This study shows that infants aged between 8 and 15 months, breast fed exclusively during the first five or six months and then introduced to solid foods, had a frequency of 4.5% of anemia, while those infants weaned at 4.5 months and then given cow's milk and solid foods at the corresponding age, had a prevalence of anemia of 38%, while evidence of iron deficiency was found in 5% and 81% of children respectively. Those results suggested a protective effect of maternal milk against iron deficiency in those infants.

The hematological results from the Bari community should be analyzed separately. The Campo Rosario community showed several striking results on three micronutrient deficiencies. Prevalence of vitamin B_{12} deficiency is outstanding. Sixty four per cent of the total population showed values below 150 mμg/L, 29% below 100 mμg/L, and 8% below 50 mμg/L. Dietary vitamin B_{12} deficiency is an unusual finding among populations. The present information is probably one of only two reports found in the literature. Only strict vegans who avoid not only meat, but also eggs and milk, have developed such a deficiency (13-17), with neurological manifestations in one case (16). The largely vegetarian diets consumed by people in many areas of India and other developing countries, contain enough available vitamin B_{12} to meet the body's requirements. Presumably, it comes largely from the contamination of food and water supplies (15). Vitamin B_{12} deficiency is also found in elderly populations (18-21), due mainly to dietary deficiency. In the case of the Campo Rosario community, such deficiency is probably mainly due to the almost vegetarian diet because the indians do not have the access to the traditional sources of wild animals as when they live in their natural enviroment. Although 97% of the sera tested showed antibodies against *Helicobacter pylori*, there was no relationship between the B_{12} seric level and these antibodies.

Folate deficiency is also high. Ninety one per cent of the total population have serum folate below 3 mg/L, 73% below 2 mg/L, and 43% below 1 mg/L. A high preva-

lence of this deficiency has been found in several countries of Asia and Africa, in populations with limited diets of starch and grains, little animal protein and little fresh green vegetables (20-23). In a number of these areas the deficiency is associated with tropical sprue.

The diet of the Campo Rosario community is similar to that of the population described. They consume pasta or rice, and sweet manioc, but sprue like diarrhea was not observed.

Regarding the impairment of iron metabolism, the high prevalence of anemia (54% in the total population, and 66% in adult females), does not correspond to the relatively low serum ferritin deficiency. Twenty per cent of the total population has values below 12 mg/L. Such a difference could be due to the nutritional deficiencies already mentioned, plus infection processes, particularly skin and parasitic infections. the low serum iron concentration of the total population is in agreement with the prevalence of iron deficiency and infection.

The more nutritious diet of the Saimadoyi community which lives in the mountains and is adapted to the enviromental conditions present, is reflected in the absence of vitamin B_{12} deficiency and only a 6% folate deficiency for the total population. The high prevalence of anemia, 31% of the total population with 27% of low serum iron and only 5% of low serum ferritin values, could be due to skin infections and to hepatitis B (21). On the other hand, the average of the population from this community had serum ferritin levels above 50g/L which suggest the possibility of inflammatory processes.

ACKNOWLEDGEMENTS

The present work was supported by Fundación Zumaque (Maravén), Consejo de Desarrollo Científico y Humanistico (Condes) from La Universidad del Zulia and Consejo Venezolano de Investigaciones Científicas (Conicit).

REFERENCES

1- Oficina Central de Estadística e Informática (OCEI). XII Censo de población de Venezuela. Tiempo de resultados. 1992; 2:2.

2- CROSBY W.H.; MUNN J.L.; FURTH E.W.: Standarizing a method for clinical hemoglobinometry. U.S. Armed Forces Med J 1954; 5:693-703.

3- CARAWAY, W.T.: Macro and micro methods for the determination of serum iron binding capacity. Clin Chem 1963; 9: 188-189.

4- FLOWERS C.A., KIUZON M., BEARD J.L., SKILENE B.S., COVELL A.M., COOK J.: A serum ferritin assay for prevalence studies of iron deficiency. Am J Hemat 1986; 23:141-151.

5- OSKY F.A.: Iron deficiency in infancy and childhood. N Eng J Med. 1993; 329:190-193.

6- TAYLOR P.G., MARTÍNEZ-TORRES C., MÉNDEZ-CASTELLANO H., BOSCH V., LEETS I., LAYRISSE M.: Relationship between iron deficiency and anemia in venezuelan children. Am J Clin Nut 1993; 58:215-218.

7- CARRUYO-VIZCAÍNO C., DIEZ-EWALD M., VIZCAÍNO G., ARTEAGA-VIZCAÍNO M.: Concentración de hemoglobina y nutrientes en una población estudiantil adolescente de bajos recursos económicos. Relación con el rendimiento académico. Invest Clín 1990; 31:189-208.

8- CHACÍN-BONILLA L., SÁNCHEZ-CHÁVEZ Y.: Prevalence of cryptosporidium and other intestinal parasites in a Bari indian population from Zulia State. Venezuela. Am J Trop Med Hyg 1994; 51:285.

9- PONS A.R., DE VILLAMAÑÁN A., NÚÑEZ-MONTIEL A., PÉREZ B., DE VALMORILLA E., DE GUSENDOS V., VARGAS G.: Los Motilones. Aspectos médico-sociales. Kasmera 1962; 1:11-69.

10- WILBERT J., LAYRISSE M., LAYRISSE Z.: Demographic and biological studies of the Warao indians. University of California. Los Angeles. Latin American Center Publications 1980; pp 160-169.

11- FRANCO E., HERTRAMPF E., RODRÍGUEZ E., ILLANES J.C., PALACIO L., LLAGUNO S., LETELLIER A.: Nutrición de hierro en lactantes mapuches alimentados con leche materna (2da. etapa). Rev Chil Pediat 1990; 61:248-252.

12- HINES J.D.: Megaloblastic anemia in adult vegan. Am J Clin Nut 1966; 19:360-368.

13- WINAWER S.J.: Gastric and hematological absorption anomality in a vegan with nutritional vitamin B12 deficiency. Gastroenterology 1967; 53: 130-135.

14- CARMEL R.: Nutritional vitamin B12 deficiency. Ann Int Med 1978; 88:647-649.

15- MURPHY M.F.: Vitamin B12 deficiency due to a low cholesterol diet in a vegetarian. Ann Intern Med 1981; 94:57-67.

16- LAYRISSE M., ROCHE M., BAKER S.J.: Nutritional anaemias. Chapter 3, in: Nutrition and Preventive Medicine. WHO Publication. Geneva 1976; pp 55-82.

17- LINDENBAUM J., STABLER S.B., PENNYPACKER L.C., ALLEN R.H., KELLY J.P., MATHEWS L.M., GRISSBY J., KAYE K.: High prevalence of cobalamin deficiency in the elderly. J Am Geriatr 1992; 40:1197-1204.

18- YAO Y., YAO S.L., LOW W.: Prevalence of vitamin B12 deficiency among geriatric outpatients. K Fam Pract 1992; 35:524-528.

19- NORMAN E.J., MORRISON J.A.: Screening elderly population of cobalamin (vitamin B12) deficiency using the urinary Methylmalonic acid assay by gas chromatography mass

spectrometry. Am J Med 1993; 94:989-993.
20- LINDENBAUM J., ROSEMBERG Y.H., WILSON P.W.F., STABLER S.P., ALLEN R.H.: Prevalence of cobalamin deficiency in the Framinghan elderly population. Am J Clin Nutr 1994; 60:2-11.
21- SIAG S.C., ENGLAND N.W.J., OBRI W.: Megaloblastic anemia in asians in Singapore. T. R. Soc Trop Med Hyg 1966; 60:668-675..
22- TURNER P.P.: Megaloblastic anemia in the Coast Province General Hospital during 1960. T R Soc Trop Med Hyg 1963; 57: 34-40.
23- CHANARIN Y.: The Megaloblastic anemia. Blackwell Scientific. London. 1979.