

## A Biochemical Study in Anemic Children in Iran

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Various forms of anaemia including nutritional deficiencies, haemoglobinopathies and red cell enzyme deficiencies (particularly glucose-6-phosphate-dehydrogenase) are known to occur in Iranian children. Their relative incidence, however, has not been adequately studied.

Inasmuch as the paediatric Haematology Clinic Tehran University has access to a large patient population that represents a cross section of different socio-economic and ethnic groups in the country, it seemed appropriate to study this problem.

### MATERIAL AND METHODS

Patients were referred from the paediatric departments and general clinics of the hospitals in various parts of Iran to the paediatric haematology clinic of the University of Tehran. They were all untreated patients. Their ages ranged from 2 months to 16 years.

Routine haematological examinations including microhaematocrit, red blood cell, white blood cell, reticulocyte counts were performed by the standard methods. Haemoglobin was measured by cyanmethaemoglobin method (5).

Serum iron and total iron binding capacity (TIBC) were assayed by the method of Caraway (3). Red cell glucose-6-Phosphate-dehydrogenase (G.6.P.D.) assay was performed by the ultraviolet spectrophotometric method using the kit manufactured by Boehringer (C.F. Boehringer and Soehne GmbH. Mannheim. Germany).

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Fetal haemoglobin was measured by the method of Singer et al (14).

Haemoglobin electrophoresis was carried out by the method of Morengo-Rows (10). Guaiac test was performed for the detection of occult blood in the feces (4).

### RESULTS

161 anaemic children, that formed 61% of the total number of the patients referred to the clinic, were studied from July 1969 to August 1970. Of these, 111 (68.8%) were males and 50 (31.2%) were females (Table I). Haemoglobin concentration ranged from 1.7 gm% to 10.4gm%.

Iron deficiency anaemia: Iron deficiency was the most frequent cause of anaemia and was present in 65 patients (40.3%). Blood loss was the cause of iron deficiency in 12 of these patients (7.5%) (Table I) and the remaining 53 had nutritional iron deficiency anaemia (32.8%) (Table I).

Iron deficiency secondary to bleeding was mostly due to chronic blood loss, in 2 patients with haemophilia, one Von wilbrand disease, 6 idiopathic thrombocytopenic purpura, 2 nose bleeding and one thrombasthenia.

Patients with nutritional iron deficiencies were from the low socio-economic bracket who were taking very little or no meat and eggs. They were in the age range from 9 months to 16 years; only one patient of 2 months had iron deficiency anaemia which occurred following an exchange transfusion soon after birth.

History of pica was present in 47%, and history of high milk intake with almost no solid food in 7.5% of cases of nutritional iron deficiency anaemia. The latter were the children below the age of three years. Only one patient had hookworm infestation.

All patients had very low serum iron, high total iron binding capacity (Table II) and showed absence of iron granules in the bone marrow.

Haemoglobinopathies: There were 26 cases of anaemia due to haemoglobinopathies (16.0%) (Table I), 23 of them had major thalassemia (14.2%); one patient had sickle cell disease, one sickle cell thalassemia, and one haemoglobin E. Thalassemia.

All cases of major thalassemia had increased serum iron and normal or low total iron binding capacity (Table II).

There were 37 cases of malignancies (23.3 %) (table I) of which, 18 were of lymphoblastic leukaemia (11.3 %), 9 monomyeloblastic leukaemia (5.6 %), 3 reticulum cell sarcoma, 3 chronic myelogenous leukaemia, 2 erythroleukaemia, one malignant lymphoma with metastasis to the bone marrow and one Hodgkin's disease.

Infection: Viral, bacterial and protozoan infections were the causative factor of anaemia in 14 cases (8.6 %). Viral infection produced haemolytic anaemia in 8 cases.

Red cell enzyme deficiency: Erythrocyte G.6.P.D. deficiency was the fundamental reason for anaemia in 4 cases, 3 male and one female; all had history of fava beans ingestion and of very low or no erythrocyte G.6.P.D. activity.

Table 1.  
Incidence of anaemia in different sex

Diseases	Female		Male		Total	
	Number	%	Number	%	Number	%
1) Nutritional iron deficiency anaemia	39	24.2	14	8.6	53	32.8
2) Iron deficiency anaemia secondary to chronic blood loss	7	4.3	5	3.2	12	7.5
3) Major Thalassemia	17	10.5	6	3.7	23	14.2
4) Other haemoglobinopathies	1	0.6	2	1.2	3	1.8
5) Lymphoblastic leukaemia	13	8.1	5	3.2	18	11.3
6) Other malignancies	15	9.5	4	2.5	19	12.0
7) Anaemia secondary to infection	7	4.3	7	4.2	14	8.6
8) Aplastic anaemia	5	3.2	2	1.3	7	4.5
9) Anaemia secondary to G.6.P.D. deficiency	3	1.9	1	0.6	4	2.5
10) Dimorphic anaemia	2	1.2	0	0	2	1.2
11) Anaemia secondary to acute bleeding	1	0.6	1	0.6	2	1.2
12) Hereditary spherocytosis	1	0.6	0	0	1	0.6
13) Autoimmune haemolytic anaemia	0	0	1	0.6	1	0.6
14) Megaloblastic anaemia	0	0	1	0.6	1	0.6
15) Systemic lupus erythematosus	0	0	1	0.6	1	0.6
<b>Total</b>	<b>111</b>	<b>63.8</b>	<b>50</b>	<b>31.2</b>	<b>161</b>	<b>100</b>

Table 2. Haemoglobin, reticulocyte count, serum iron and total iron binding capacity

Disease	Haemoglobin gm%	Reticulocyte count %	serum iron mcg%
Nutritional Iron deficiency Anaemia Mean and stand deviation	2.7—10.5 7.0+2.3	0.1—5 1.5+1.0	13.9—69 42.8+22.2
Iron deficiency secondary to chronic blood loss	1.7—9.9 6.7+2.61	0.1—13 3.8+3.8	16.0—62 37.9+15.0
Major Thalassemia	1.7—9.3 6.0+1.84	1—10 5.3+2.67	81—380 182.4+84.9
Lymphoblastic leukaemia	2.4—10.5 6.7+2.66	0.1—7 3.0+2.2	
Mono-myeloblastic leukaemia	3.8—6.6 5.0+0.86	0.1—6 2.9+2.4	
Anaemia secondary to infection	4.4+10.5 8.1+1.86	0.3—6 3.5+2.1	
Aplastic anaemia	4.0—8.4 5.6+1.55	0.5—5 2.9+1.9	

## DISCUSSION

The picture obtained in this survey reflects the incidence of various types of anaemias in Iranian children referred to the paediatric haematology clinic. The most significant finding is the high percentage of nutritional iron deficiency in children of all ages. Considering that the iron deficiency might be present without anaemia (8) its actual incidence is probably much higher.

Nutritional iron deficiency anaemia is usually restricted to the first 2 years of life. Between the ages of 3 to 16 years only 15% of the anaemic children studied by Lahey (9) had nutritional iron deficiency anaemia, while in this study the figure is 28.6%. This high incidence is mostly due to the poor diet in all age groups and to pica.

Continuous occult blood is another cause of iron deficiency specially in those who have had history of diarrhoea (6,11,13), however occult intestinal bleeding can be secondary to the iron deficiency anaemia (7).

Intestinal bleeding was not present in any of the patients studied here except in the one who had hookworm infestation.

Amongst haemoglobinopathies, B-thalassemia is very common in Iran (12) and is seen in 14.2 % of the cases studied here. Most of them are from the northern part of Iran.

The other common cause of anaemia found in this study is leukaemia specially lymphoblastic type. This high incidence may be partly due to the referral of the blood malignancies in Iran to our clinic.

Infection produced anaemia in 14 patients (8.6 % of total). Acute haemolytic anaemia occurred in 8 patients who were judged, on a clinical basis, to have viral infection.

Erythrocyte G.6.P.D. deficiency is fairly common in Iran and is found in 8 % of the Moslem population (1,2) and 15 % of the Mamassanian tribal groups, while in this study it is only 2.5 %. All the cases had severe haemolysis following fava beans ingestion. The actual incidence of this red cell enzyme deficiency is for this obvious reason much higher.

#### Summary:

161 anaemic children from the age of 2 months to 16 years were studied in the University of Tehran Department of Experimental Medicine.

Iron deficiency anaemia was found in 65 patients (40.3 %); of these 53 were nutritional (32.8 % of total) and 12 due to chronic blood loss (Idiopathic thrombocytopenic purpura, epistaxis etc). Of 37 cases (23.3 %) of malignancies 27 (16.9 %) were of acute leukaemia. There were 26 cases (16.0 %) of haemoglobinopathies, and of these 23 had major thalassemia (14.2 % of total). Viral, bacterial and protozoan infections produced anaemia in 14 cases (8.6 %) and erythrocyte G.6.P.A. deficiency caused anaemia in 4 cases (2.5 %).

### Resumé

161 enfants anémiques âgés de 2 mois à 16 ans furent étudiés au Département de la Médecine Expérimentale de l'Université de Téhéran.

65 malades (40.3 %) présentaient une anémie ferriprive, parmi lesquels se trouvaient 53 cas d'anémies de cause nutritionnelle (32.8 % de tous les malades) et 12 cas dûs d'une hémorragie chronique (Purpura thrombocytopénique idiopatique, épistaxis etc...). Parmi 37 cas d'anémie de cause maligne (23.3 %), 27 malades (16.9 %) étaient atteints de leucémie. Chez 26 malades (16 %), l'anémie était due à une hémoglobinopathie dont 23 cas (14.2 % de tous les malades) de la thalassémie majeure. Les infections virales, bactériennes ou d'origine protozoaire, étaient responsables dans 14 cas (8.6 %) et le déficit en G.6.P.D. érythrocytaire était retrouvé chez 4 malades (2.5 %).

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