ORIGINAL REPORT

Frequency of Thalassemia, Iron and Glucose-6Phosphate Dehydrogenase Deficiency among Turkish Migrating Nomad Children in Southern Iran

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Abstract: Ferropenia and consequent iron deficiency anemia (IDA), β-thalassemia, and glucose 6-phosphate dehydrogenase (G6PD) deficiency are three main common hematological problems in Iran. This study was conducted to investigate the prevalence of these problems in Turkish migrating nomads in southern Iran. From June to October 2006, the blood sample of 152 Turkish migrating nomadic children including 79 (52%) males and 73 (48%) females were evaluated for iron indices and G6PD deficiency in southern Iran. The family history of thalassemia, favism, and signs and symptoms related to anemia of participants were determined. RBC count, different types of Hb, Hct, MCV, MCH, MCHC, RDW, SI, TIBC and SF were measured immediately after blood sampling. Twenty-seven (17.7%) children had serum ferritin (SF) level <12 ng/dL, while this low serum ferritin level was similar in both genders. The low hemoglobin (Hb) level had a statistical correlation with the low serum ferritin level. Among all participants, the prevalence of G6PD deficiency was 7.2% which was more frequent in males compared to females (8.9% vs. 5.5%). Seven (4.6%) children had Hb ≥ 3.5 g/dL; and the prevalence of β-thalassemia trait was higher in female children compared with males (5.5% vs. 3.8%). The prevalence of IDA was 17.7%. Although this figure is less than the prevalence found in other developing countries (25-35%); but it shows that Turkish ethnic nomads in southern Iran are still behind the health statues in the industrialized countries (5-8%). The relatively high prevalence of β-thalassemia trait also is a major potential risk; and careful performance of Iranian thalassaemia program is highly suggested. It seems that G6PD deficiency is a prevalent disease in migrating Turkish nomads, and again establishment of educational programs, and investigation of dietary habits of Turkish migrating nomads on how and by whom the fava beans are consumed; seems to be a good way to prevent favism.

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Key words: Iron deficiency, thalassemia, G6PD deficiency, nomads, Southern Iran

Introduction

The hemoglobinopathies, especially β-thalassemia, are important health problems in Iran (1-3). The high prevalence of β-thalassemia drains health resources and drastically affects family and personal life (4). There has been extensive research on β-thalassemia mutation spectrum in the Iranian population (5-8) and national thalassaemia screening programs were implemented in 1997. By the end of 2001, over 2.7 million prospective couples had been screened and 10298 at risk couples had been identified. The rise over the first three years reflects increasing coverage, plus an annual 7.4% increase in number of individuals reaching marriageable age. As the programme has become established, the average prevalence of carrier couples detected has increased from 3.0/1000 to 4.5/1000 (9). Ferropenia and iron deficiency anemia (IDA) are also common hematological problems throughout the world, and an enormous public health problem in developing countries. It is estimated that more than 500 million people worldwide are affected by this disease (10). Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an X-linked disorder, which can lead to acute hemolytic anemia following ingestion of fava beans, and certain drugs and bacterial or viral infections. Favism, has been a well-known disease in Iran, and is a major public health problem in many regions of Iran (11, 12). Migration, illiteracy, malnutrition, familial marriage, and some cultural beliefs in different ethnic

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Table 1. Prevalence of different factors related to anemia in Turkish migrating nomads

Anemia related factors	Yes		No	
	No.	percent	No.	Percent
Availability of safe drinkable water	48	31.6%	104	68.4%
Family history of thalassemia	4	2.6%	148	97.4%
Family history of favism	3	2%	149	98%
Pica	27	17.8%	125	82.2%
Anorexia	16	10.5%	136	89.5%
Agitation	56	37.1%	95	62.9%
Pallor	47	30.9%	105	69.1%

groups may produce variations in the prevalence of thalassemia, G6PD deficiency, and ferropenic disorders. Undoubtedly, collecting national data from different ethnic groups may assists in planning health services more efficiently. So that resources can be targeted to the sections of the population that need them most, and are used to the best advantage. The present study was undertaken for the first time to determine the prevalence of IDA, β-thalassemia, and G6PD deficiency in Turkish ethnic migrating nomads in Fars Province, southern Iran.

Patients and Methods

In a cross-sectional cluster random sampling, conducted in Fars Province, southern Iran, out of 395 students of Qashghai Tribe, 152 school children under 18 years old belonging to Turkish ethnic migrating nomads moving each year in summer and winter quarters up to 500 Km were enrolled by cluster random sampling method for β-thalassemia, IDA and G6PD deficiency. They were interviewed in their schools in different cities of the province concerning family history of thalassemia and favism, signs and symptoms of anemia such as pica, agitation, anorexia and pale conjunctiva, and also availability of safe drinkable water. After providing a written consent from each participant or their parents, 5 ml of blood was collected from the participants by antecubital vein-puncture. Routine hematological parameters including red blood cell (RBC) count, hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW); were measured upon blood sampling using an automated cell counter (Sysmex Klooo, Hematology analyzer). Serum iron (SI) and total iron binding capacity (TIBC) were determined by a calorimetric procedure, and serum ferritin (SF) was determined by ELIZA method (Dynex, USA). The degree of G6PD deficiency was measured by fluorescent spot (13). Determination of different kinds of hemoglobin was performed, using high performance liquid chromatography (HPLC) method (Hb-Gold, England), and Hb A2 equal or greater than 3.5 g/dL was considered diagnostic of β-thalassemia trait (14). MCV<80 fl, MCH<27 pg and Hb A2 ≥3.5% were considered as criteria for diagnosis of β-thalassemia. Anemia was defined as a Hb concentration below WHO's cut-off for age and sex (i.e., 12 g/dL for females and the 6-14-years-old males, and 13 g/dL for 15-years-old males) (15). The degree of iron deficiency was determined by the following criteria: iron depletion was defined as SF concentrations <12 ng/mL; and iron deficiency anemia as anemia accompanied by SF <12 ng/mL (16). Pearson's correlation test was performed to examine the association of Hb concentration with SF. Statistical analysis was performed using SPSS software (Version 11, Chicago, IL, USA); and statistical significance was set at $P<0.05$. The study was approved by the Ethic Committee of Shiraz University of Medical Sciences, and informed consent was obtained from each patient or their parents.

Results

Out of 152 children, 79 (52%) were male and 73 (48%) were female. Mean age was 13.1±2.4 years, and the age range was 6-18 years (median: 13 years). Regarding different factors related to anemia, 104 (68.4%) children did not have any access to safe drinkable water; 4 (2.6%) had a family history of thalassemia, and 3 (2%) had a family history of favism. The prevalence of symptoms -which are by themselves nonspecific but are related to ferropenia- was relatively high (Table 1).

Among all participants, the prevalence of G6PD deficiency was 7.2%, and it was more prevalent in males compared to females (8.9% vs. 5.5%). The mean Hb values for male and female children were 83.6±6.1 and 81.5±7.6 fl respectively for MCV (Table 2).

The mean serum iron (SI) for male and female children were 92.1±37.3 and 83±31.9 μg/dL, respectively, while these values were 25.9±22 and 27.1±17.8 ng/dL for serum ferritin (SF); and 377.7±59.5 and 360.2±62.1 μg/dL for TIBC (Table 3). Twenty-seven (17.7%) children had

Table 2. Hematological parameters in Turkish migrating nomads

Unit	Hct	Hb	MCV	MCH	RDW	MCHC	HbA2	HbF
	%	g/dL	fl	Pg/cell	%	g/dL	%	%
Male	41.4±6.4	13.3±1.5	81.5±9.6	6.8±3	13.3±1.7	32.6±1.7	2.7±0.8	0.5
Female	40.2±1.9	12.9±0.8	83.4±6	26.9±2.7	12.9±1.2	32.2±1.6	2.7±0.7	0.4
Total	40.8±4.8	13.1±1.2	82.5±8.1	26.9±2.9	13.3±1.5	32.4±1.6	2.7±0.7	0.5

SF<12 ng/dL (Table 3), and the prevalence of low serum ferritin was 19.2% in females and 17% in males. The low Hb level had a statistical correlation with the low serum ferritin (P<0.05). Seven (4.6%) children had Hb A2 ≥ 3.5% and the prevalence of β-thalassemia trait was higher in female children compared with males (5.5% vs. 3.8%; Table 3).

Discussion

Our results showed that the mean SF was 26.5±20 ng/dl. Twenty-seven (17.7%) children had a low SF level (SF<12). The low Hb and Hct levels had statistical correlation with a low serum ferritin level (P<0.05). Hence, the prevalence of IDA was 17.7%. This value is consistent with previous reports in southern Iran (17, 18), and is less than the prevalence seen in other developing countries (19). The prevalence of IDA in industrialized countries has declined in recent decades, but there has been a little change in the worldwide prevalence. The most common reason for iron deficiency anemia in children is the inadequate supply of iron in the diet. This fact is particularly prominent in developing countries where the low level of iron intake is accompanied by malaria and intestinal parasite infections. Unfortunately, there is a huge gap in the prevalence of IDA anemia in developing and industrialized countries. In a cross-sectional study, done in India, the prevalence of IDA was found to be 59.9%; (19) while in a nutritional investigation in Madrid, Spain, the prevalence of ferropenia and IDA were 4.94% and 0.94%, respectively (20).

Favism, a severe hemolytic anemia due to G6PD deficiency, has been known to exist in Iran for the past approximately 60 years, and has been reported in most regions of Iran; however most cases are reported in the Caspian area (11, 12, 21). We have detected G6PD deficiency in our study in 11 male children, and none of female children had G6PD deficiency. The prevalence of G6PD deficiency was 7.2%, which is comparable to reported data from high prevalence areas in northern Iran by Ohkura et al. that indicated an incidence of 8.6% in Mazandaran and Guilan Provinces (22). The prevalence of β-thalassemia trait was 4.6% in our study. The rate of β-thalassemia carriage is alarmingly high. Although most patients who have β-thalassemia trait are asymptomatic and are detected by an incidental decrease in Hb level and MCV; but their detection is important in prevention of β-thalassemia major. In Iran, marriage registrars routinely refer prospective couples to a designated local laboratory for premarital screening; the man's red cell indices are checked first. If he has a microcytosis cell (MHC <27 pg or MCV <80 fl), the woman is tested. When both are microcytic, haemoglobin A_2 concentration is measured. If both have a concentration of 3.5% or more (diagnostic of thalassemia trait), they are referred to a local designated health center for a genetic counseling. At risk couples attend as many counseling sessions as they need to reach an informed decision (an average of 2.5 sessions, ranging from 1 to 5). Those who marry after counseling are referred to their local health centers or health houses for a follow up until they have completed their family. Although Iranian thalassaemia program has gained relative success (23, 24), but it is still far from complete or perfect. Recently, there has been a great success in the field of bone marrow transplantation of thalassemia major patients in Iran (25-27), but obviously improving the screening programs is a much better way than this cumbersome and expensive procedure.

Table 3. Iron indices in Turkish migrating nomads

Unit	SI	TIBC	SF	SF≤12	SF≥12	HbA2<3.5	HbA2≥3.5
	µg/dL	µg/dL	ng/mL	ng/mL	ng/mL	No. (%) g/dL	No. (%) g/dL
Male	92.1±37.3	377.7±59.5	25.9±22	14 (17.9%)	64 (82.1%)	76 (96.2%)	3 (3.8%)
Female	83±31.9	360.2±62.1	27.1±17.8	13 (17.8%)	60 (82.2%)	69 (94.5%)	4 (5.5%)
Total	87.7±35	369.4±61.2	26.5±20	27 (17.9%)	124 (82.1%)	145 (95.4%	7 (4.6%)

SI: serum iron, TIBC: total iron binding capacity, SF: serum ferritin

Based upon our study, although the prevalence of iron deficiency anemia in Turkish migrating nomads in south of Iran was less than the prevalence found in other developing countries, which is alarmingly high, therefore, improved nutrition and educational programs by public health authorities may help to decrease ferropenia and iron deficiency anemia. We conclude that serum ferritin index is as accurate as Hb index in diagnosis of iron deficiency anemia. The relatively high prevalence of β-thalassemia trait seems to be a major potential risk, and careful performance of Iranian thalassaemia program is highly suggested. It seems that G6PD deficiency is a prevalent disease in migrating Turkish nomads; therefore, and again establishment of educational programs, and investigation of dietary habits of these nomads on how and by whom the fava beans are consumed, seem to be a good way to prevent favism.

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