

Dietary folate intake and concentration of folate in serum and red blood cell in a group of female university students in Tehran, Iran

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ABSTRACT

Adequate intake of folate has an important role in the prevention of nutritional anemia and other complications in childbearing age women. This study was undertaken to determine dietary folate intake and concentration of folate in serum and red blood cell (RBC) in female students of a medical university in Tehran, the capital of Iran. In this cross sectional study, 346 female students were randomly selected from students' lists of eight schools at Shahid Beheshti University of Medical Sciences in Tehran, Iran. Those who were interested and eligible participated in this study. For each student, questionnaires about general characteristics were completed. Dietary folate intake was assessed by 3 days food recall questionnaire. These data were analyzed by Food Processor (FP). Folate in serum and RBC were determined by Radio Immunoassay (RIA). The results showed that mean age and body mass index in these students were 21.4 ± 4.2 yrs and 22.2 ± 3.2 kg/m², respectively. Mean of 3 days folate intake was 239.4 ± 101.8 µg/d. The majority of subjects (93%) did not meet the reference dietary intake for folate. Mean serum folate levels in whole population was 7.8 ± 3.6 ng/ml and RBC folate was 249.6 ± 124.9 ng/ml. No correlation was found between folate concentrations in serum and RBC with folate intake from food. The result of this study showed that folate intake of students is very low. Therefore, appropriate intervention is necessary for adequate intake of folate.

Keywords: Folate intake, Serum folate, RBC folate, Female Students

INTRUDUCTION

Folate is one of the B vitamins which in forms of coenzyme play a role in the process of reduction and one-carbon units' transport including nucleotides and amino acids, therefore, it is crucial to synthesize and methylation of DNA, RNA and protein synthesis. Considering to these functions, sufficient intake of folate is important during pregnancy, lactation and infancy [1].

Low folate intake from food results in decreasing concentration of folate in serum and red blood cell (RBC) and thus increase plasma homocysteine [2]. Increasing the blood homocysteine is known as a risk factor for atherosclerosis and

cardiovascular diseases [3, 4]. The other clinical manifestations of folate deficiency include megaloblastic anemia, cancer and neurological disorders [5]. Folate deficiency during pregnancy results in Neural Tube Defect (NTD) [6], spontaneous abortion [7], placental abruption and preeclampsia [8, 9], anemia and premature delivery [10-12]. Epidemiological studies suggest that up to 75% of NTD could be prevented by increased folate intake [13, 14].

In recent years, it has been presented contradictory reports about prevalence of folate deficiency in the communities at the different age groups especially in the women of childbearing age [15]. In Iran, there are few studies

documenting the deficiency of folate. In one study in Shiraz, Southern Iran, the prevalence of folate deficiency in 20-80 years old subjects has been reported 18.5% [16]. The other study reported prevalence of 14.3% in the childbearing women in Golestan province, Northern Iran [17]. The prevalence of folate deficiency is higher in the childbearing women in Asian countries such as Lebanon (25.1%) [18] and China (24%) [19].

The aim of the present study was to assess dietary intake of folate and to determine serum and RBC concentrations of folate in a representative sample of female students at Shahid Beheshti University of Medical Sciences in Tehran, Iran.

MATERIALS AND METHODS

Subjects

In this cross sectional study, 346 students were randomly selected using stratified sampling from university student lists of eight schools at Shahid Beheshti university of Medical Sciences in Tehran, Iran [20]. Those who were interested and eligible to participate in this study signed a written consent form. Information on demographic and health characteristics of the students was collected with a structured questionnaire. Weight and height were measured in light clothing without shoes. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2).

Approval for the study was obtained from the Ethics Committee of the National Nutrition and Food Technology Research Institute, Shahid Beheshti University of Medical Sciences.

Dietary assessment

The subjects were asked to record a 3-day dietary intake which included a weekend day. Information was also obtained on the folic acid contents of the multivitamin mineral supplements (if taken). The diet records were coded by one of the principal investigators using an Iranian food composition database (Dorosty Food Processor 2003) [21], modified using the new version of the UK food composition tables [22] for the folate contents of those food items which were not included in the Iranian food composition software.

Blood Sample Collection

To measure serum and RBC concentrations of folate, 5 ml of fasting blood was collected in a test

tube, transferred to the Laboratory in cold boxes, and centrifuged (2,000 rpm for 15 min) immediately. Both serum and RBC folate concentrations were measured using a commercial radioimmunoassay kit (SimulTRACSNB Radioassay) [23].

Serum folate concentrations less than 3 ng/ml and 3-6 ng/ml were considered as severe and marginal deficiency, respectively [24]. RBC folate levels less than 140 ng/ml and 140-200 ng/ml were considered as severe and marginal deficiency, respectively [24]. The recommended dietary allowance (RDA) of 400 g for food folate was used to define adequacy of intakes [25].

Statistical Analysis

SPSS for Windows (version 11) was used for all statistical procedures. Summaries of numerical variables are presented as means and standard deviations (SD). Pearson's coefficient of correlation (r) was used to test for linear relationships between numerical variables. Statistical significance was set at $p < 0.05$.

RESULTS

Subjects

346 students took part in this study. The mean age and body mass index in students were 21.4 ± 4.2 years and $22.2 \pm 3.2 \text{ kg}/\text{m}^2$. The beginning of menstrual period was almost similar (13.3 ± 1.2 yrs) and monthly bleeding were all reported moderate. Twelve percent consumed multivitamin and/ or mineral supplements containing folic acid.

Dietary Intake

Daily folate intake from food is shown in table 1. Mean folate intake was about 60% of the RDA (400 $\mu\text{g}/\text{d}$). The majority of subjects (93%) did not meet the reference dietary intake for folate.

Hematological status

Mean concentrations of folate in serum and RBC are shown in table 1. Biochemical analysis showed that the mean serum and RBC folate were within the normal range ($>6 \text{ ng}/\text{ml}$ and $>200 \text{ ng}/\text{ml}$, respectively).

Table 1. Folate status of the studied population

	Mean	SD
Folate intake ¹ ($\mu\text{g}/\text{d}$)	239.4	101.8
Serum folate ² (ng/ml)	7.8	3.6
RBC folate ² (ng/ml)	249.6	124.9

¹ 346 valid, 0 missing.

² 341 valid, 5 missing

Table 2. Number of students at different levels of folate concentrations in serum and RBC (n=341)

	No. of students (%)
Serum folate	
<3 ng/ml	12 (3.5)
3- 6 ng/ml	110 (32.3)
>6 ng/ml	219 (64.2)
RBC folate	
<140 ng/ml	52 (15.2)
140-200 ng/ml	94 (27.6)
>200 ng/ml	195 (57.2)

Table 3. Comparison of mean serum folate concentration in studied students with the published data in the selected countries

	Serum folate (ng/ml)	Reference
China	11.4	29
Croatia	10.2	30
UK	8.9	31
Iran (Tehran)	7.8	This study
Poland	6.3	26
Iran (Golestan)	6	17
Italy	5.5	27
Bangladesh	5.4	28
France	5.3	27

Table 4. Comparison of mean folate intake in studied students with the published data in the selected countries

	Folate intake (µg/d)	Reference
Lebanon	275	34
Canada	262	35
Austria	255	36
Greece	247	37
Iran (Tehran)	239	This study
Finland	205	32
Iran (Golestan)	198	17
Netherlands	172	33
Croatia	156	30

Number of students at different levels of folate concentrations in serum and RBC is shown in Table 2. Insufficient serum folate concentrations (<3 ng/ml) were present in 3.5% of students and 15.2% of them had RBC folate levels less than 140 ng/ml. No correlation was found between folate concentrations in serum and RBC with folate intake from food. The serum folate concentrations were higher in multivitamin/ mineral supplement users than in non-users ($p < 0.0001$).

DISCUSSION

The present study was carried out to assess of the folate status and the magnitude of its deficiency among female university students. The findings of our study showed that mean serum folate concentration of subjects was within the normal range and only a small number of them had suboptimal levels (<3 ng/ml). The number of subjects who had RBC folate less than normal was greater than those who had low serum folate levels, suggesting the long term folate intake had been low.

For comparison with the results of the present study, table 3 shows serum folate concentration among women of childbearing age in selected countries. The mean serum folate of the subjects in our study (7.8 ng/ml) was higher than that of women in Golestan province (located in the North of Iran) [17], Poland [26], France and Italy [27] and Bangladesh [28], but lower than the mean serum folate of women in China [29] and Croatia [30]. However, the mean serum folate of female students in this study was close to the mean serum folate of English women [31] (table 3).

As table shows table 4, the mean folate intake of subjects in our study is higher than the folate intake of women in Golestan province, Iran [17], Finland [32], Netherlands [33], Croatia [30], but lower compared to Lebanese [34], Canadian [35] and Austrian women [36]. Our findings on the folate intake of students are similar to intake data of Greece women [37].

The results of the present study showed insufficient folate status of Iranian female students. Therefore, the authors recommend the appropriate intervention for adequate intake of folate.

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