STUDY OF WOMEN'S IRON-DEFICIENCY ANAEMIA IN REPRODUCTIVE AGE REFERRED TO OBSTETRIC AND GYNECOLOGY CENTER OF HOSPITAL

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Abstract — *We studied the prevalence of iron-deficiency anaemia in women of reproductive age, between 15 to 49, with a mean age of 31.56±1.34 years, attending Mirzakoochekkhan Hospital OB. GYN. Center for routine gynecological and obstetrical examination. We compaired mean values for the serum tests and haematological data and investigated etiological factors such as age, marital status, education, spouse's education, occupation, spouse's occuption, number of days of menstrual bleeding, severity of menstrual bleeding, pregnancy status, number of pregnancies, number of deliveries, intervals between successive pregnancies, and smoking status, as probable causes of iron-deficiency anaemia in women. Moreover the relevance between occurance of iron-deficiency anaemia or ferritin serum level to etiological factors and diagnostic laboratory tests are analyzed. A serum diagnosis of iron-deficiency was accepted on the basis of one or more of the following test results: serum ferritin levels below 12 μgl⁻¹ with or without transferrin saturation below 16%. For the purpose of this study anaemia was difind as haemoglobin (Hb) below 12 gdl⁻¹. Women have been classified into two groups of anaemic Vs normal according to the diagnosis. Prevalence of anaemia among 41 subjects with complete laboratory results was 36.58%. Moreover, the probability of occurance of iron-deficiency anaemia, in general population was found to be 33.3%. As a result a significant relationship was observed between occurance of iron-deficiency anaemia and diagnostic laboratory tests including serum ferritin, serum iron, total iron-binding capacity (TIBC), transferring saturation (%), Hb, haematocrit (Hct), mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), and etiological factors such as number of days of menstrual bleeding, severity of menstrual bleeding. Same relationship was observed between serum ferritin levels and above etiological factors and laboratory tests except for MCHC and Hct. Comparison of mean values for the continous variables showed significant differences between parameters such levels of serum ferritin and iron, TIBC, transferrin saturation (%), Hb, Hct, MCH, MCV, MCHC, number of days of menstrual bleeding in two groups. Moreover, since red cell indices including Hct, MCV, MCH, and MCHC in anaemic group are still within normal ranges and mean of Hb levels in these subjects fall above 10 g dl⁻¹, studied women were suffering from a mild anaemia. Severe menstrual bleeding, among categorial variables, occured profoundly in women suffering from iron-deficiency anaemia. Therefore it can be suggested that menorrhagia was the most common single cause of anaemia among women in the study.*

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Key words: Anaemia., iron-deficiency., women., reproductive age.

INTRODUCTION

Iron-deficiency anaemia is a worldwide problem. Indeed, the worldwide prevalence of iron deficiency anaemia is such as to rank it among the commonest chronic maladies of humankind. Data of the World Health Organization show that anaemia, due principally to iron deficiency, affects approximately 30 percent of the world's population, and that approximately 43 percent of preschool children, 51 percent of pregnant women, and 37 percent of school-age children are anaemic (DeMaeyer & Adiels-Tegman 1985).

Although all segments of the population can be affected, the highest incidence occurs in women of the reproductive age (Beveridge et al. 1965; Dallam et al. 1984; Kilpatrick 1961; Kuvibidila et al. 1994; Mcfee 1979). The incidence is much higher in under developed nations (Daouda et ala. 1991; Hercberg et al. 1987; Isah et al. 1985; Kuvibidila et al. 1994) compared to developed countries (Rybo 1985; Scott & Pritchard 1967; Uchida et al., 1988).

In order to study the prevalence of iron-deficiency anemia and to evaluate variations of diagnostic laboratory tests including serum ferritin, serum iron, total iron-binding capacity (TIBC), transferrin saturation (%), haemoglobin (Hb), haematocrit (Hct), red cell count, mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), and mean corpuscular haemoglobin concentration (MCHC) in two groups of anaemic and normal women of the reproductive age, as well as to identify etiological factors such as age, marital status, education, spouse's education, occupation, spouse's occupation, number of days of menstrual bleeding, severity of menstrual bleeding, pregnancy status, number of pregnancies, number of deliveries, intervals between successive pregnancies, and smoking status probably responsible for the iron-deficiency anaemia, we have prospectively studied 41 women conforming to specific criteria defined in patients and methods section, attending Mirzakoochakkhan Hospital OB. GYN. Center in Tehran for routine gynecological and obstetrical examination between May and October

1995.

MATERIALS AND METHODS

Patients

In the present study, detailed haematological data and etiological factors probably responsible for the iron-deficiency anaemia and their statisical analysis are reported in 41 women of reporductive age, between 15 to 49, with a mean age of 31.56 ± 1.34 years, attending Mirzakoochakkhan Hospital OB. GYN. Center for routine gynecological and obstetrical examination.

All 41 women conformed with the following criteria:

1. They had not received supplemental iron during the previous year.
2. They had no blood donation or transfusion during the previous year.
3. They had no history of previous illness of any severity. Since varied illnesses e.g. inflammation, infection, liver disease can affect diagnostic laboratory tests including serum ferritin, serum iron, and TIBC (Blake et al. 1981; Cartwright & Lee 1971; Cook 1982; Dallman et al. 1980; Lipschitz et al. 1974; Prieto et la. 1975), only women who felt perfectly well at the time of interview were included.
4. They had no family history of anaemia.
5. none of the subjects breast-fed her child.
6. They had not received oral contraceptives during the previous year. It has been confirmed that serum iron and TIBC were strikingly elevated in women taking oral contraceptives (Burton 1967; Mardell & Zilva 1967). These women therefore used other ways of prophylaxis such as condoms.

Anaemia was defined as Hb below 12 g dl^{-1} (World Health Organization 1968). Iron deficiency was defined as serum ferritin levels below 12 μgl^{-1} with or without transferrin saturation below 16% (Bainton & Finch 1964; Jacobs et al. 1972). Iron-deficiency anaemia was defined as either Hb<12 gdl^{-1} and transferrin saturation<16%; Hb<12 gdl^{-1} and serum ferritin<12 μgl^{-1}; or all three indices below normal.

The women, accordingly have been classified into two groups of anaemic Vs normal depending on the diagnosis.

In considering the importance of the effect of different etiological factors on occurance of iron-deficiency anaemia certain criteria were kept in mind: Education, for the purpose of this study, referes to either spouses, holding a high school diploma or higher degree Vs grades below high school diploma. Woman's occupation is classified as either a house-wife or employed, whereas spouse's occupation is classified as employed Vs self employed. In addition, the effect of other eitiological factors including age, marital status, number of days of menstrual bleeding, severity of menstrual bleeding, pregnancy status, number of pregnancies, number of deliveries, intervals between successive pregnancies, and smoking status on prevalance of iron-deficiency anaemia was also studied. Moreover, to define severe menstrual bleeding, one or more of the following criteria must conform: bleeding extended over seven days, heavy bleeding in the form of cloths for more than one day, or the regular and necessary use of more than 1½ packets of pads (Beveridge et al. 1965).

It has been confirmed that Hb levels are significantly higher in smokers that in non-smokers and that this increase is directly related to the number of cigarettes smoked daily. Therefore to avoid underestimation of prevalence of anaemia among smokers following alterations were made. For a person smoking 10-19 cigarettes a day, $3gl^{-1}$ was added to minimum level of Hb used to diagnose anaemia. Consequently, $5gl^{-1}$ addition for smokers of 20-39 cigarettes a day, $7gl^{-1}$ addition for smokers of 40 or more cigarettes a day was considered. No adjustment was used for women who smoked less than 10 cigarettes per day (Nordenberg et al. 1990).

Laboratory Methods

Blood samples were obtained in the morning from the antecubital vein. Besides we noticed that the subjects must be in overnight fasting state in order to remove the effect of lipemia and plasma cloudiness.

10 ml of venous blood was taken from each subject, and bout 2 ml collected into tubes containing EDTA for the determination of Hb, Hct, red cell number and indices by an automated analyzer, Baker 9010 Cell Counter (Sereno Diagnostics, inc., U.K.).

The remainder 8 ml was promptly centrifuged at 1060×g for 10 minutes. After centrifugation, the serum was used to assay serum ferritin level, iron level, and TIBC.

Serum iron and TIBC were determined by an autoanalyzer spectrophotometer, Ciba-Corning, 550-Express (Ciba, inc., U.K.).

Serum ferritin level was measured by radioimmunoassay using an automatic gamma counting system, Gamma Matic I, Kontron (Kontron, Switzerland) and a commercially available RIA kit (Amersham, U.K.).

Transferrin saturation (%) was calculated by dividing serum iron level by TIBC and multiplying the results by 100.

Statistical Analysis

The distribution of the studied variables were tested by means of Kolmogorov-Smirnov normal distribution test, and was found to be Gaussian.

Therefore, the statistical significance of difference between variables in two groups of iron-deficient anaemic Vs normal was assessed by Student's unpaired t-test for continous variables and by chi-squared method and, additionally in certain groups, by the Fisher exact probability test for categorial variables.

The linear correlation coefficient was used in testing relationships. For determining the importance of the effect of certain background variables on the occurance of anaemia or serum ferritin level, the discontinous variable, i.e. smoking status was given notional numerical values (e.g. + 1 for smoker, -1 for non-smoker).

Serum ferritin levels were analyzed in relation to certain variables due to the fact that serum ferritin level is the best indicator of iron-deficiency anaemia (Burns et al. 1990; Guyatt et al. 1990; Jacob et al. 1980; Jacobs et al. 1972; Joosten et al. 1991; Lipschitz et al. 1974).

Furthermore, to analyze the probability of prevalence of iron deficiency anaemia in general population, Binomial test was used. The upper limit for statistical significance was set at $P<0.05$.

RESULTS

There were significant correlations between the occurance of iron-deficiency anaemia and diagnostic laboratory tests including serum ferritin, serum iron, TIBC, transferrin saturation (%), Hb, Hct, MCH, MCV, MCHC, and etiological factors such as number of days of menstrual bleeding, and severity of menstrual bleeding (Table 1).

Similar correlation was found between serum ferritin levels and above mentioned variables with the exception of Hct and MCHC (Table 2).

In an attempt to compare continous and categorial variables in two groups of anaemic Vs normal, significant differences were observed in serum ferritin, serum iron, TIBC, transferring saturation (%), Hb, Hct, MCH, MCV, MCHC, number of days of menstrual bleeding (continous) as well as in severity of menstrual bleeding (categorial) (Tables 3 & 4).

Moreover, the probability of occurance of iron deficiency anaemia, in general poupulation was found to be 33.3%. In other words 1/3 of women in reproductive age are at risk of suffering iron deficiency anaemia ($P<0.05$).

Table 1. Relationship between the occurance of iron-deficiency anaemia and different variables.

Variables	Correlation with occurance of anaemia (r)
Serum ferritin (μgl^{-1})	0.638**
Serum iron (μgdl^{-1})	0.785**
TIBC (μgdl^{-1})	0.706**
Transferrin saturation (%)	0.803**
Hb (gdl^{-1})	0.570**
Hct (%)	0.440*
Red cell count ($x10^{12}l^{-1}$)	0.183
MCH (pg)	0.447*
MCV (fl)	0.551**
MCHC (gdl^{-1})	0.431*
Age (year)	0.020
Marital status	0.042
Education	0.169
Spouse's education	0.022
Occupation	0.128
Spouse's occupation	0.010
Number of days of menstrual bleeding	0.377*
Severity of menstrual bleeding	0.477**
Pregnancy status	0.262
Number of pregnancies	0.067
Number of deliveris	0.056
Intervals between successive pregnancies (year)	0.055
Smoking status	0.092

Values expressed show the linear correlation coefficients (r) between variables and the occurance of anaemia in studied subjects (n=41). Asterisks indicate significant relationship between variables and the occurance of anaemia (*$P<0.01$, **$P<0.001$).

Table 2. Relationship between the serum ferritin level and different variables.

Variables	Correlation with serum ferritin level (r)
Serum iron (μgl^{-1})	0.562***
TIBC (μgdl^{-1})	0.529***
Trnasferrin saturation (%)	0.603***
Hb (gdl^{-1})	0.357*
Hct (%)	0.282
Red cell count ($x10^{12}l^{-1}$)	0.019
MCH (pg)	0.381**
MCV (fl)	0.481***
MCHC (gdl^{-1})	0.281
Age (year)	0.019
Marital status	0.073
Education	0.147
Spouse's education	0.004
Occupation	0.197
Spouse's occupation	0.089
Number of days of menstrual bleeding	0.490***
Severity of menstrual bleeding	0.493***
Pregnancy status	0.203
Number of pregnancies	0.039
Number of deliveris	0.045
Intervals between successive pregnancies (year)	0.005
Smoking status	0.058

Values expressed show the linear correlation coefficients (r) between variables an the serum ferritin level in studied subjects (n=41). Asterisks indicate significant relationship between variables and the serum ferritin level (*$P<0.05$, **$P<0.02$, ***$P<0.01$).

Table 3. Mean values of continous variables in normal and anaemic subjects.

Variables	Normal women (n=26)	Anaemic women (n=15)
Serum ferritin (μgl^{-1})	76.8±8.4	9.5±0.9***
Serum iron (μgdl^{-2})	87.0±4.7	34.3±3.2***
TIBC (μgdl^{-1})	381.9±4.2	467.7±11.9***
Transferrin saturation (%)	22.6±1.2	7.4±0.7***
Hb (gdl^{-1})	13.8±0.2	10.9±0.5***
Hct (%)	41.2±0.5	36.4±1.4**
Red cell count ($\times 10^{12} l^{-1}$)	4.7±0.2	4.6±0.1
MCH (pg)	29.4±0.3	26.7±0.9*
MCV (fl)	87.3±0.8	80.1±1.9**
MCHC (gdl^{-1})	33.6±0.2	32.6±0.4*
Age (year)	31.7±1.7	31.3±2.3
Number of days of menstrual bleeding	5.7±0.4	7.4±0.3**
Number of pregnancies	2.5±0.5	2.2±0.5
Number of deliveris	2.2±0.4	2.1±0.5
Intervals between successive pregnancies (year)	2.4±0.4	2.2±0.6

Values are expressed as mean±SEM. Numbers in parentheses indicate the numbers of subjects in eaach group.
*P<0.02, **P<0.01, ***P<0.001, compared to the normal women (Student's t-test).

Table 4. Incidences of categorial variables in normaala and naemic subjects.

Variables	Normal women (n=26)	Anaemic women (n=15)
Marital status-Married	18/26 (69%)	10/15 (67%)
Woman's education-High school dipolma	10/26 (38%)	7/15 (47%)
Spouse's education-High school diploma	14/26 (54%)	7/15 (47%)
Woman's Occupation Employed	8/26 (31%)	6/15 (40%)
Spouse's Occupation Employed	17/26 (65%)	12/15 (80%)
Severe menstrual bleeding	4/26 (15%)	9/15 (60%)*
Pregnancy status pregnant	1/26 (4%)	3/15 (20%)
smoking status smoker	2/26 (8%)	2/15 (13%)

Values (except percentages) refer to the number of subjects conforming to the criteria over the total number. Differences among two groups were analysed by the chi-squared test or Fisher exact probability test and are indicated as follows: *P<0.01, when campared with the corresponding values of the normal women.

DISCUSSION

The persent study suggests that the pervalence of anaemia is high in Iranian women studied. Such a high prevalence has been previously observed in the under-developed countries (Daouda et al. 1991; Hercberg et al. 1987; Isah et al. 1985; Kuvibidila et al. 1994). The findings of this study is in accordance with data form WHO which show that anaemia, due principally to iron deficiency affects approximately 30 percent of the world's population (Demaeyer & Adiels-Tegman 1985).

A significant relationship was proven to exist between occurance of iron-deficiency anaemia or serum ferritin levels as the best indicator or iron deficiency and diagnostic laboratory tests including serum tests for iron deficiency and haematological data. Such observation supports the accuracy and precision of laboratory tests used to diagnose iron-deficiency anaemia.

According to previous studies serum laboratory tests to diagnose iron-deficiency anaemia are of greater value compared to red cell indices in a way that relying on red cell indices alone, will lead to a 30 percent misdiagnosis of iron-deficiency anaemia (Fairbanks & Beutler 1995). In this study we also found a greater relationship in terms of higher linear correlation coefficients between serum tests as opposed to red cell indices except for MCV.

It has also been shown that when red cell indices are determined by automated cell-counting methods, the MCV is much more sensitive than other red cell indices (Fairbanaks & Beutler 1995). Our results confirm such observation.

In an evaluation of differences between diagnostic laboratory test's mean values in two groups of normal Vs anaemic subjects, identical to above results were obtained. It's notable that although differences exist between red cell indices values in two groups, these indices in anaemic subjects are still within normal ranges with mean Hb levels being above 10 g dl^{-1}. Since the red cell indices are consistently abnormal in adults only when iron-deficiency anaemia is moderate to severe (Hb<10gdl^{-1}) (Bainton & Finch 1964; Beutler 1959; Fairbanks & Beutler 1995), it can be concluded that anaemic subjects in this study suffered from mild anaemia.

In a study of etiological factors, a significant relationship was observed between number of days or severity of menstrual bleeding and the occurance of iron-deficiency anaemia or serum ferritin levels as the indicator of iron deficiency. Moreover significant difference is profoundly observed when comparison is made between normal and anaemic subjects. Obtained results are consistent with previous studies that identified menorrhagia as one of the most common causes of iron-deficiency anaemia among women (Beveridge et al. 1965; Hallberg et al. 1966; Jacobs & Butler 1965). It has also been indicated that increased volume of menstrual bleeding can be the result of iron-deficiency anaemia (Taymor et al. 1960; 1964), which is a matter of controversy in another study (Jacobs & Butler 1965).

Other etiological factors however, showed no significant relationship to the occurance of iron-deficiency anaemia or serum ferritin levels. Moreover the lack of such relationship was obtained from a comparison of data in normal Vs aanaemic group.

All evidence confirm the fact that iron-deficiency anaemia is most prevalent among women of reproductive age (Beveridge et al. 1965; Dallam et al. 1984; Kilpatrick 1961; Kuvibidila et al. 1994; Mcfee 1979). However this prevalence is not specific to a certain age during reproductive years (Aziz-Karim et al. 1990; Dallman et al. 1984), as is evident from the results of this study.

In our study no relationship could be found between pregnancy status and anaemia. It is reported that pregnancy can not be a cause of anaemia in women with proper iron stores before the start of pregnancy (Dawson & McGanity 1987; De Leeuw et al. 1966; Ho et al. 1987). Other factors relevant to pregnancy also showed to have no impact on anaemia owing to the fact that the number of pregnancies and the number of deliveris as well as the intervals between successive pregnancies are considered to be proper enough to reserve body stores of iron. Above facts can imply the success of family planning programs in Iran.

From previous investigations, it was known that smoking can not cause anaemia which is reflected through our results. Smoking however, can increase Hb levels and therefore can cause misdiagnosis of anaemia (Nordenberg et al. 1990).

It has been known that either spous's education and occupation can directly determine the socioeconomic level of the family. Low income levels therefore can cause poor nutrition and improper diet which in terms can put women at risk of suffering iron-deficiency anaemia (Aziz-karim et al. 1990; Beveridge et al. 1965; Finch 1969). Since no relationship was found between above factors and the prevalence of anaemia in our study, an acceptable or equal socioeconomic levels for all subjects can be concluded.

Marriage in our study was not found to be a causative factor for iron-deficiency anaemia. This could mean that marriage has not made the women of this study prone to factors causing iron-deficiency anaemia. In conclusion, the high prevalence of iron deficiency anaemia in women of reproductive age, and other health problems that are expected consequences of this disorder, it is required that health professionals specially Health Ministry pay more attention to this vital matter. Prevention programs as well as educating and supporting women of reproductive age could be the beginning steps towards overcomming this problem. Some of the plans that are already on the way in other countries with satisfactory results are fortifying women's diet with iron, increase use of iron tablets as well as ascorbic acid which enhances iron absorption (Fairbanks & Beutler 1995; Hallberg et al. 1979).

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