Relationship of Anemia and Serum Ferritin in Medical Students

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ABSTRACT

Aims Anemia occurs for different reasons. However the Iron Deficiency Anemia (IDA) is one of the most prevalent causes of anemia in all human communities. The goal of the present study was to assess the effect of serum Ferritin deficiency on anemia in medical students.

Materials & Methods This cross-sectional study was conducted on students of Kashan University of Medical Sciences in all educational stages in 2011. 323 students were selected randomly. The hemoglobin, hematocrit, MCV, MCH, MCHC, ferritin and RDW indices were measured. The data was analyzed by SPSS 13 statistical software using Chi-square and ... T tests.

Findings The mean of ferritin level in all samples was 46.2±42.8ng/ml, hemoglobin was 13.1±1.4g/dl, hematocrit was 39.2±5.2%, MCV was 85.4±6.4fl, MCH was 29.2±6.1%, MCHC was 32.9±1.3g/dl and RDW was 13.6±0.5g/dl. 62 of studied individuals (19.2%) had minor anemia and 261 (80.8%) were normal. 31 of studied individuals (9.6%) had ferritin deficiency and 292 (90.4%) had normal ferritin. There was a significant difference between anemia according to gender (p=0.001) and educational level (p=0.01). Ferritin deficiency had also significant difference according to gender. According to gender, there were significant differences in ferritin, hemoglobin, hematocrit and RDW levels. According to age, there were significant differences between ferritin and hematocrit and RDW levels. MCHC level had significant difference according to living site of the students.

Conclusion Girl university students are at the risk of anemia caused by lack of ferritin and aging increases the risk of anemia.

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[1] Nutritional anaemias: Report of a WHO Scientific Group [2] Iron deficiency and cognitive achievement among school-aged children and adolescents in the United States [3] Nutritional anaemias [4] Body iron is associated with cognitive executive planning function in college women [5] Effect of iron deficiency anemia on audiovisual reaction time in adolescent girls [6] Prevalence of anemia among pregnant women and adolescent girls in 16 districts of India [7] Prevalence of iron deficiency anemia among adolescent schoolgirls from Kermanshah, Western Iran [8] Status of iron deficiency anemia in female students at third degree level of high school in Kashan [9] Iron deficiency anemia in a group of Turkish adolescents: frequency and contributing factors [10] Iron deficiency anemia in Dubai Medical College for Girls: A preliminary study [11] The study of iron deficiency anemia prevalence among aja nursing faculty students, Tehran [12] Iron deficiency anaemia in reproductive age women attending obstetrics and gynecology outpatient of university health centre in Al-Ahsa, Saudi Arabia [13] A method for preparing silica-containing iron (III) oxide adsorbents for arsenic removal [14] Homocysteine and vitamin B12 status and iron deficiency anemia in female university students from Gaza Strip, Palestine [15] Interaction of iron deficiency anemia and hemoglobinopathies among college students and pregnant women: A multi center evaluation in India [16] Prevalence of iron-deficiency anaemia among university students in Noakhali region, Bangladesh [17] Prevalence of iron deficiency anaemia and thalassaemia trait among undergraduate medical students [18] Prevalence of anemia and microcytic anemia among women in north-western Tabriz [19] Iron deficiency anemia in adolescents; a literature review [20] Socioeconomic status and puberty are the main factors determining anaemia in adolescent girls and boys in East Java, Indonesia [21] Mean hemoglobin levels in venous blood samples and prevalence of anemia in Japanese elementary and junior high school students [22] Assessment of the prevalence of iron deficiency anemia, by serum ferritin, in pregnant women of Southern Iran [23] Prevalence and severity of anemia and iron deficiency: Cross-sectional studies in adolescent schoolgirls in western Kenya [24] Estimating the intake of dietary factors related to iron deficiency anemia in non-pregnant women aged 15-45 years old in Zanjan [25] Risk and prevalence of anemia among women attending public and private universities

Introduction

According to WHO (World Health Organization) definition, anemia is defined in the basis of hemoglobin less than 13mg/dl in mature men and less than 12mg/dl in mature women [1]. Although anemia has different causes, its most prevalent cause in all human communities is iron deficiency. The prevalence of IDA (iron deficiency anemia) differs by country, geography and personal characteristics [2].

Iron is an essential element in the processes of erythropoiesis, metabolism and growth and development. After the embryonic period, the most common way of entering iron to body is edible, so the role of proper nutrition to provide this essential element is clear and undeniable. The body is in essential need to receive iron in childhood, adolescence, maturity and pregnancy [2]. The lack of iron supply can lead to major physical and mental disorders, the most important of which are anemia, growth retardation, skin and nail disorders, decreased mental and muscle functions [3-5]. The main causes of iron deficiency are absorption deficiency, malabsorption and gastrointestinal tract and reproductive system bleeding [3].

In the United States, the level of iron deficiency is as little as 3% in children and 8.7% in girls [3]. The prevalence of IDA is about 90% in high school teenagers in India [6]. Iran is also one of the countries with high prevalence of iron deficiency and resulted anemia [7, 8]. This status is more intensified in women due to several causes among which menstruation and rigid diets for weight loss are the mains. Different statistical data from all parts of Iran have reported the prevalence of IDA. For example, the iron deficiency anemia has been reported 21.4% and iron deficiency 23.7% in girl students of Kermanshah City, Iran, in 2008 [7] and anemia has reported to be 15.1% in 1997 in the high school girl students of Kashan City, Iran [8]. In 2000, iron deficiency anemia has been reported in 21% of teenagers in Turkey [9].

Although the university studying period has the higher risk of nutrition problems, the focus of previous studies was mostly on children and teenagers and few studies have been conducted amongst the university students. Ayoub has shown that 88.4% of the UAE girl university students have minor anemia, 7.2% have average anemia, and 2.3% have major anemia and has suggested dietary advices for them [10]. Pishgouei & Khoshsima have shown in 2005 that 16.9% of nursery students of Iran have IDA; 20.5% in girls and 6.8% in boys. As they have reported, 37% of Iranian nursery students are at the risk of IDA but it has no significant relation with dormitory lifestyle, which is mostly equivalent with nutrition problems [11]. In Saudi Arabia, anemia has been reported as 54.8% in female university students [12]. This prevalence has been shown 10% with 33% of low ferritin in another research [13], 20% in Gaze [14] and 38.1% in India [15]. Also, 55% of all university students in Noakhali, Bangladesh, have shown to have anemia, 36% of them were male [16]. Prevalence of IDA and thalassemia trait among undergraduate medical students has been reported 14% in Malaysia Medical Centre [17].

In fertilization age, the adult women and teenager girls have great potential for iron deficiency and the caused anemia. Anemia may occur or be intensified amongst the university students and girls especially during their studentship period due to changes in type of nutrition, dormitory lifestyle, family distance, mental and psychological problems and mental and psychological anorexia and lead to the educational failures, weakness, fatigue and mental and psychological disorders. Regarding this, the goal of the present study was to assess the effect of serum Ferritin deficiency on anemia in medical students.

Materials & Methods

This cross-sectional study was conducted on students of Kashan University of Medical Sciences in all educational stages who were studying there at 2011. According to similar studies [10, 11] and based on Kukran formula, the number of samples was estimated 310 (z=1.96; d=0.05). By considering the cooperation rate and also the gender portion of the studied population (3:1, girls:boys), 355 samples (100 boys and 255 girls) were selected from the studying society randomly.

The hemoglobin, hematocrit, MCV, MCH and MCHC indices were measured by Hycel Hematology Cell Counter (Celly; Austria), while the serum ferritin was measured using

its exclusive kit (Diasorian; Italy) and Chemi-Luminescence reader (Lison; Italy).

The hemoglobin levels less than 12g/dl in girls and 13g/dl in boys, the hematocrit level less than 36%, the MCV level less than 80fl, the MCH level less than 26%.

The severities of anemia based on iron deficiency in both groups were investigated based on the standard level of hemoglobin and ferritin indices. The hemoglobin levels less than 13g/dl in men and 12g/dl in women and the serum ferritin less than 15ng/ml in men and 12ng/ml in women were considered as iron deficiency [23].

To determine the hematological and biochemical indices, 5ml venous blood was taken by syringes. The amount of 2ml of blood was poured into tube containing EDTA anticoagulant substance (Asahi; Japan) and the remains was poured into simple tube and sent to the laboratory.

The data was analyzed by SPSS 13 statistical software using Chi-square (to compare qualitative variables between groups) and Independent T and analysis of variance (to compare quantitative variables between groups) tests.

Findings

The age mean of all samples was 21.3±2.2 years (21.1±2.0 years for women and 21.9±2.5 years for men).

The mean of ferritin level in all samples was 46.2±42.8ng/ml (7-294ng/ml), hemoglobin was 13.1±1.4g/dl (9.3-19-6g/dl), hematocrit was 39.2±5.2% (28.8-48.8%), MCV was 85.4±6.4fl (37.0-96.1fl), MCH was 29.2±6.1% (19.3-26.2%), MCHC was 32.9±1.3g/dl (22.4-37.1g/dl) and RDW was 13.6±0.5% (11.3-17.4%).

62 of studied individuals (19.2%) had minor anemia and 261 (80.8%) were normal. 31 of studied individuals (9.6%) had ferritin deficiency and 292 (90.4%) had normal ferritin. There was a significant difference between anemia according to gender (p=0.001) and educational level (p=0.01). Ferritin deficiency had also significant difference according to gender (p=0.04; Figure 1).

Figure 1) The distribution frequency (Numbers in parentheses are percentages) of samples with- and without ferritin deficiency and with- and without anemia according to sex, age groups, marriage status, educational level and living site

Parameters	No Anemia	Minor Anemia	No Ferritin Deficiency	With Ferritin Deficiency
Gender				
Female (n=230)	174 (53.8)	56 (17.2)	203 (88.3)	27 (11.7)
Male (n=93)	87 (26.9)	6 (1.8)	89 (95.7)	4 (4.3)
p Value		0.001		0.04
Age groups				
≤20 (n=135)	108 (33.4)	27 (8.3)	121 (89.6)	14 (10.4)
21-22 (n=118)	102 (31.5)	16 (4.9)	110 (93.2)	8 (6.8)
≥23 (n=70)	51 (15.7)	19 (5.8)	61 (7.1)	9 (12.9)
p Value		0.071		0.301
Educational level				
Associate (n=96)	85 (26.3)	11 (3.4)	89 (92.7)	7 (7.3)
Bachelor (n=155)	115 (35.6)	40 (12.3)	137 (88.4)	18 (11.6)
Master and up (n=72)	61 (18.8)	11 (3.4)	66 (91.6)	6 (8.?)
p Value		0.01		0.404
Marriage status				
Single (n=293)	239 (73.9)	54 (16.7)	265 (90.4)	28 (9.6)
Married (n=30)	22 (6.8)	8 (2.4)	27 (90.0)	3 (10.0)
p Value		0.22		0.201
Living site				
Dorm (n=281)	243 (86.4)	38 (13.6)	256 (91.1)	25 (8.9)
Home (n=42)	34 (80.9)	8 (19.1)	36 (85.7)	6 (14.3)
p Value		0.211		0.202

According to gender, there were significant differences in ferritin, hemoglobin, hematocrit and RDW levels (p<0.05). According to age, there were significant differences between ferritin and hematocrit and RDW levels (p<0.05). MCHC level had significant difference according to living site of the students (p<0.05; Figure 2).

Figure 2) Comparing the mean of some blood variables according to gender, age, marriage status, educational level and living site Independent T and ANOVA test

Parameters	RDW	MCHC	MCH	MCV	Hct	Hgb	Ferritin
Gender							
Female	13.5±0.53	32.9±1.2	28.8±5.0	85.5±6.6	37.4±4.5	12.6±1.0	32.8±25.3
Male	13.7±0.53	32.9±1.4	29.9±8.2	85.3±5.4	43.9±2.8	14.6±1.1	79.4±57.1
p Value	0.022	0.8	0.147	0.776	<0.001	<0.001	<0.001
Marriage statues							
Single	13.6±0.5	33.0±1.1	29.3±6.3	85.4±6.8	39.4±4.6	13.1±1.3	44.2±39.2
Married	13.6±0.7	32.4±2.3	28.2±1.9	85.8±4.3	37.5±8.1	13.2±1.5	65.9±66.5
p Value	0.111	0.204	0.382	0.753	0.206	0.841	0.089
Educational level							
Associate	13.9±0.6	33.0±1.4	30.0±9.1	86.2±4.4	40.4±5.0	13.6±1.5	42.8±39.4
Bachelor	13.5±0.6	32.9±1.0	29.0±5.0	84.7±8.0	38.7±4.7	12.9±1.4	43.6±39.8
Master	13.4±0.5	32.1±0.7	27.9±2.4	84.8±6.0	42.2±3.9	14.0±1.2	95.5 ±66.6
Doctor and up	13.5±0.4	32.8±1.6	28.5±1.9	86.1±4.0	38.5±5.8	13.0±1.1	54.0±50.1
p Value	0.111	0.204	0.381	0.752	0.206	0.841	0.089
Living site							
Dorm	13.6±0.5	33.0±1.2	29.1±5.6	85.6±6.2	39.5±4.4	13.1±1.4	46.7±43.5
Home	13.7±0.7	32.7±1.4	29.7±9.9	84.1±79.7	38.8±6.5	13.2±1.4	38.9±32.3
Rental home	13.5±0.3	32.1±1.9	28.2±2.1	85.9±4.9	34.4±12.2	12.9±1.2	56.3±52.2
p Value	0.357	0.033	0.818	0.339	0.186	0.999	0.603
Age							
≤20	13.5±0.6	33.0±0.9	28.8±2.4	85.6±7.3	38.8±4.4	12.9±1.3	35.3±27.6
21-22	13.6±0.5	33.0±1.3	29.5±8.3	85.5±5.0	40.3±4.8	13.4±1.5	50.3±46.6
≥23	13.5±0.5	32.0±1.8	29.2±6.7	85.02±6.4	38.3±6.3	13.03±1.4	60.4±60.4
p Value	<0.001	0.1	0.681	0.782	0.011	0.831	<0.001

Discussion

It should be noted that the most previous studies on anemia and iron deficiency have been conducted amongst women and high school girl students, junior school girl students and pregnant women [9, 18-21]. It seems that the university students in Iran have been ignored. So, the aim of this paper was to determine the prevalence of anemia and iron deficiency amongst the medical students of Kashan University.

The anemia level (Hgb<13 for men and Hgb<12 for women) has been obtained 1.8% in men and 17% in women and the ferritin index of iron deficiency (ferritin less than 12) has been obtained 4.3% in men and 11.7% in women. The assessment of anemia by mentioned criteria in majority of studies was identical with the indices used in the present study [7, 10, 22, 23].

The anemia prevalence was approximately equal with many of the researches conducted in Iran and regional countries. The level of anemia prevalence according to implemented studies was 21.4% in Kermanshah, Iran [7], 20% in India [5], 26.7% in Emirate [10], 21.1% in Kenia [23], 16.9% in Tehran, Iran [11] and 23.8% in Zanjan, Iran [24]. But, the level of ferritin deficiency in the present study was different from studies conducted in different

areas; 23.7% in Kermanshah, Iran [7], 27.5% in India [15], 30.3% in Zanjan, Iran [24], 19.8% in Kenia [19] and 38.8% in Tehran, Iran [11].

Ayoub have mentioned in his study at 1995 that anemia is 1.8% and iron deficiency is 4.3% in men, which shows the necessity of studying the reasons of anemia and iron deficiency in men. In addition, this conclusion is certified in Pishgouei & Khoshsima [11]. However, anemia and iron deficiency are significantly and obviously at higher level in women. It seems that in addition to malnutrition, a blood loss during menstruation in women is the uppermost important reason, which needs further consideration.

The notable blood indices consist of MCHC, Hct, MCV, Hgb and MCH, which were all at the normal range but the least normal. It shows that while 20% of students are in anemia range (minor), the average index tends downward. It means that the students are at the risk of anemia. These indices were also studies in some other researches. UAE girl students have shown 15.9% of microcytic anemia (MCV<80fl) and 1.5% of macrocytic anemia (MCV>96fl) [10]. 14.5% of iron deficiency anemia have been reported based on MCHC, 47.3% based on Hct and 24.2% based on serum iron in Zanjan, Iran [24]. The

studies in Kermanshah City, Iran, and India [5] have reported that these indices are less than normal level.

In addition to the blood indices, variables of gender, age, educational level, type of house, place of residence and marital status were also examined in the present study. gender was significantly effective in the incidence of anemia (p<0.001) and iron deficiency (p=0.04). The Hct mean was also obviously low in female individuals. The married life was not a risk factor for anemia, although there was no significant relation between two single and married groups (p=0.22); maybe due to the insufficient married cases. No significant relation was reported between married life and iron deficiency anemia in other studies [11]. Anemia had a significant relationship with the level of education (p=0.01). Amongst the four educational groups, the group holding Bachelor of Arts degree significantly experienced more levels of anemia in comparison to other educational groups. Although one of the reasons could be the maximum population of this group of students in university, other probable reasons could be highly informed students in higher educational level or preventive mechanisms of anemia including assistance, family support and existence of iron reserves from high school periods. Although in other researches, high education level is not a preventable factor for anemia [25]. Different age groups had no significant impact on the incidence of anemia (p=0.071) or ferritin deficiency (p=0.301) that could be due to the lack of mental distractions in university students. Our type of categorization (<21, 21-22 and older than 23 years) had no impact on the incidence of anemia and iron deficiency. However, the age mean of individuals with anemia was significantly higher than normal individuals. This may indicate that aging increases the risk of anemia (No similar study was found). The reasons maybe the family distance, reduced family support in term of nutrition, increased mental and psychological problems, following dietary disorders and termination of iron supplementation plan in high schools. The initial impression is that the type of dormitory dietary habits could be effective in the prevalence of anemia and ferritin shortage. The results of the present study however indicated that this is not an authentic consumption in a way that the average hemoglobin and ferritin was identical in three studied groups (private house, rental house and dormitory) and no significant difference was found. In the study conducted in Dubai University of Medical Sciences, the Egyptian students showed higher level of anemia compared to other students, which could be probably due to the changes in nutrition habits and family distance [10].

The limitation of this study was that some participants did not cooperate with us, thus were replaced with others. The results of the present study showed that almost 20% of students were infected with anemia and 19.1% had iron deficiency. Considering that about 2000 students are enrolled at the University, almost 400 individuals have anemia and iron deficiency. Since these people are at the risk of anemia and iron deficiency side effects, periodic review, and monitoring of these indices seems necessary. Besides, the necessity of investigating the effects of anemia, including educational failure and physical illnesses is evident. On the other hand, it is essential to make efforts to inform the students of their personal status modify and improve dietary habits and train the subjects of anemia, its symptoms and side effects. Many researches show that attention and completion of above cases have obviously led to the improvement of hematologic parameters [11, 23, 24]. So, the improved dietary habits and awareness of students and authorities on the side effects and impacts of anemia should be considered.

Conclusion
Girl university students are at the risk of anemia caused by lack of ferritin and aging increases the risk of anemia.

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