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Adolescents and Anemia

Seda Ocak[1], Onder Kilicaslan[2], Zeynep Yildiz Yildirmak[3], Nafiye Urganci[4]

ABSTRACT:

Adolescents and anemia

Objective: Anemia in adolescents is a significant health problem caused by multiple factors. With this study, we aimed to investigate anemia aetiology and its frequency among the adolescents.

Material and Method: A total of 74 patients were admitted to Pediatrics Clinic of Istanbul Şişli Hamidiye Etfal Training and Research Hospital between January 2012 and August 2013, who were aged between 10-19 years and diagnosed with anemia, were investigated regarding the aetiology.

Results: Female and male ratio were 74.3% and 25.7%, respectively, and the mean age of the patients was 14.7±1.8 years. The most common symptom was fatigue. Red meat consumption was detected to be low in patients who were diagnosed with iron deficiency anemia (IDA). Six of the patients had a history of bleeding. Menorrhagia was present in 23.6% of the females. As a result of certain laboratory tests, 81.1% of the patients were diagnosed with IDA. The aetiological evaluation revealed that the most common reason for the anemia was nutritional. Vitamin B12 deficiency and folic acid deficiency anemia were diagnosed in 13.5% and 1.4% of patients, respectively. Eleven patients underwent endoscopy, and the most common finding was gastritis. Apart from these diagnosis, we reported acute leukaemia in 3 patients, sepsis in 3 patients, hereditary spherocytosis, autoimmune hepatitis, autoimmune hemolytic anemia, aplastic anemia, a chronic renal failure and cholangitis in one patient each. While 39.2% of the patients were treated with hospitalization, 60.8% of the patients were under outpatient follow-up and treated.

Conclusion: An inappropriate diet and eating habit is the most common aetiology of anemia among the adolescents. Considering that this age group of patients are not under routine health care follow-up of pediatricians, it is necessary to examine the adolescent for anemia for early diagnosis, with investigating the causes and selecting the appropriate treatment.

Keywords: Adolescent, anemia, nutrition, iron deficiency

ÖZET:

Adolesanlar ve anemi

Amaç: Adolesan dönemde anemi birçok faktöre bağlı olarak gelişebilen ciddi bir sağlık sorunudur. Bu çalışmada; adolesan dönemde anemileri araştırarak etiyolojide yer alan hastalıkları gözden geçirmeyi ve bu hastalıkların sıklığını tartışmayı amaçladık.

Gereç ve Yöntem: İstanbul Şişli Hamidiye Etfal Eğitim ve Araştırma Hastanesi Çocuk Sağlığı ve Hastalıkları Kliniği'ne bağlı servis ve polikliniklerde Ocak 2012-Ağustos 2013 tarihleri arasında 10-19 yaş arası anemi tespit edilen 74 hastanın etiyolojik yönden araştırması yapıldı.

Bulgular: Hastaların %74.3'ü kız, %25.7'si erkekti ve yaş ortalaması 14.7±1.8 idi. En sık şikayet halsizlikti. Demir eksikliği tanısı alan hastalarda kırmızı et tüketiminin az olduğu tespit edildi. Kanama öyküsü 6 hastada vardı. Kız cinsiyetteki hastaların %23.6'sında menoraji mevcuttu. Yapılan laboratuar tetkikleri sonucunda hastaların %81.1'ine demir eksikliği anemisi tanısı kondu. Etiyolojik araştırmada konulan tanılar arasında en sık olanı nütrisyonel demir eksikliği oldu. Hastaların %13.5'inde B12 eksikliği tespit edilirken, %1.4'ünde folik asit eksikliği saptandı. Endoskopi 11 hastaya yapıldı ve en sık gastrit saptandı. Bu tanılar dışında 3 hasta akut lösemi, 3 hasta sepsis, 1 hasta herediter sferositoz, 1 hasta otoimmun hepatit, 1 hasta otoimmun hemolitik anemi, 1 hasta aplastik anemi, 1 hasta kronik böbrek yetmezliği, 1 hasta kolanjit tanısı aldı. Hastaların %39.2'si servise yatırılarak tedavi edilirken %60.8'i ayaktan takip ve tedaviye alındı.

Sonuç: Adolesan döneminde anemi nedenlerinin başında sağlıksız beslenme gelmektedir. Çocuk hekimleri olarak bize nadiren başvuran bu yaş grubunda sağlık takiplerini düzenli yapmak, sağlık sorunlarını erken tespit edip nedenlerine yönelik araştırmayı ve uygun tedaviyi yapabilmek gerekir.

Anahtar kelimeler: Adolesan, anemi, beslenme, demir eksikliği

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[1]Koc University Hospital, Department of Child Health and Diseases, Istanbul - Turkey
[2]Duzce University, Faculty of Medicine, Department of Pediatric Emergency Science, Duzce - Turkey
[3]Health Sciences University, Sisli Hamidiye Etfal Application and Research Center, Department of Pediatric Hematology, Istanbul - Turkey
[4]Health Sciences University, Sisli Hamidiye Etfal Application and Research Center, Department of Child Gastroenterology, Istanbul - Turkey

Address reprint requests to / Yazışma Adresi:
Onder Kilicaslan,
Duzce University, Faculty of Medicine, Department of Pediatric Emergency Science, Duzce - Turkey

E-mail / E-posta:
onderkilicaslan1983@gmail.com

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INTRODUCTION

The World Health Organization (WHO) defines the 10-19 years of age group as the adolescence period. Today we need to understand the problems of this age group better, considering that there are about 1.2 billion children in this age group, and that these children will make the adult age group of tomorrow (1).

Anemia is considered as an important health problem because of the adverse effects on mental and physical development during childhood (2). However, as the adolescents do not refer to pediatricians very often, the diagnosis and treatment of the anemia may be delayed and the patients may apply with a severe anemia picture.

As a result of inadequate and unbalanced nutrition of children in adolescence, the intake of vitamins (A, B6, B12, C, folic acid) and calcium, iron and zinc decreases considerably (3). At the top of the reasons affecting the iron balance in this period, is the amount of iron intake in the diet. The tendency to become vegetarian, increased fast-food consumption, increased snacking are the main reasons for reduced iron intake. Iron absorption also increases with increased growth rate. Because men have more muscle mass, they need more iron (4). In females, blood loss with menarche is an important factor that increases iron absorption but negatively affects iron balance. Menorrhagia increases the risk of iron deficiency anemia (IDA) (5).

Diseases such as gastrointestinal structural lesions, varices, polyps, colitis, hereditary telangiectasias, peptic ulcers can lead to anemia by causing bleeding during adolescence. Intestinal parasites can also cause loss of iron from digestive system by reducing absorption (6). Inflammatory bowel diseases (IBD) can lead toIDA by both bleeding and by chronic malabsorption.

Anemia is a frequent cause of admission in primary bone marrow diseases and diseases that make bone marrow infiltration, which cause bone marrow failure (7).

In this study, we aimed to investigate the anemia that constitutes a serious health problem during the adolescence period which is one of the important stages of human life and to discuss the etiological diseases and to discuss the frequency of these diseases for the adolescence period.

MATERIAL AND METHOD

The etiological evaluation was performed in the light of history and physical examination of 74 patients with anemia, between 10-19 years of age, who were followed in inpatient and outpatient clinics of the Department of Pediatrics and Clinics of Istanbul Şişli Hamidiye Etfal Training and Research Hospital (ŞHETRH) between January 2012 and August 2013. The approval for the study was obtained from the ŞHETRH Ethics Committee (25.09.2012-97). Written consent was obtained from the families of the patients who agreed to participate in the study.

The targeted age group was defined as adolescence period according to WHO. According to WHO definition of anemia, hemoglobin (Hb) value lower than 12 g/dl in females and lower than 13 g/dl in males were accepted.

Patients were examined in terms of age, gender, breast milk and/or formula milk intake, pica history (eating soil, lime, sand), complaints, bleeding history, menstruation in females (menorrhagia; changing more than 8 pads per day) and pathological physical examination findings. The weight, height, percentile and body mass index (BMI) (kg/m^2) of the patients were calculated. Body mass index (BMI) to be below 18 kg/m^2 was acppeted as being underweight. Consumption of food (red meat, legumes, molasses) is classified (less than 1 time per month, less than 3 times per week, more than 3 times per week). More than three times a week were rated as frequent and few were rated as low consumption.

Peripheral smear, reticulocyte count, direct Coombs, serum iron, iron binding capacity (TIBC), ferritin, vitamin B12 levels, folic acid level, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), fecal occult blood test (FOBT), stool parasite and Helicobacter pylori (H.Pylori) stool antigen (HpSA) tests were selected and performed according to patient characteristics.

Patients with a serum iron level below 30 ug/dl, and with a serum ferritin level below 12 ng/ml were defined as IDA, with vitamin B12 levels below 200 pg/ml were defined as B12 deficiency, and with folic acid levels below 4.8 ng/ml were defined as folic acid deficiency. Following endoscopic examination and

biopsy evaluation in patients who did not respond to oral iron treatment despite correct use in patients with gastrointestinal system (GIS) hemorrhage, FOB or H. pylori; gastritis, gastrointestinal ulcer, esophagitis, duodenitis and IBD were diagnosed.

Statistics

Mean, standard deviation, ratio and frequency values were calculated in the descriptive statistics of the data. The distribution of the variables was controlled by the Kolmogorov-Smirnov test. Chi-square test was used in the analysis of the quantitative data, Fischer's test in the absence of chi-square test conditions, and paired t-test and Wilcoxon test in the repeated measurement analysis. Statistical Package for Social Sciences (SPSS) 21.0 program was used in the analyses. Data are given as mean±standard deviation, percent (%) and range (minimum-maximum). The results were evaluated in a confidence interval of 95% and a significance level of $p<0.05$.

RESULTS

The study was conducted with 74 patients between 10 and 19 years of age diagnosed with anemia. The mean age of the patients was 14.7±1.8 (min:10, max:19) years. Of the patients, 55 were female (74.3%), and 19 were male (25.7%).

Forty-three patients (58.1%) had fatigue, 15

Table-1: History of consumption of breast milk and/or formula milk, pica history, and the results of consumption of red meat, legume and molasses

		n	%
Histroy of consumption of breast milk	Absent	11	14.9
	Present (Male/Female)	63 (15/48)	85.1
History of consumption of formula milk	Absent	37	50
	Present (Male/Female)	37 (12/25)	50
Histroy of pica	Absent	68	91.9
	Present	6	81
Consumption of red meat	<1/month	33	44.6
	<3/week	34	45.9
	>3/week (Male/Female)	7 (3/4)	9.5
Consumption of Molasses	<1/month	30	40.5
	<3/week	42	56.8
	>3/week (Male/Female)	2 (1/1)	2.7
Consumption of legumes	<1/month	33	44.6
	<3/week	35	47.3
	>3/week (Male/Female)	6 (2/4)	8.1

Table-2: The relationship between red meat consumption and anemia

	Consumption of Red Meat		p
	Less	Frequent	
	Mean±Standard Deviation	Mean±Standard Deviation	
Hemoglobin (gr/dl)	7.50±2.43	8.90±2.13	0.011
Hematocrit (%)	25.10±6.94	28.50±5.94	0.026
Erithrocyte Count (/mm^3)	3.86±1.06	4.07±0.91	0.370
MCV (fL)	67.98±17.08	71.38±12.26	0.324
RDW (%)	21.17±6.50	18.45±3.32	0.023
Leukocyte Count (/mm^3)	7283±2049	9419±8861	0.794
Neutrophil Count (/mm^3)	4369±1689	5039±3398	0.311
Thrombocyte Count (/mm^3)	314485±174677	268951±113362	0.180
Reticulocyte (%)	1.09±0.66	1.09±0.90	0.699
Iron (ug/dl)	28.52±37.42	40.28±34.09	0.002
Iron Binding Capacity (ug/dl)	449.64±97.59	428.77±97.25	0.368
Ferritin (ng/ml)	28.05±82.46	42.01±125.56	0.012
Transferrin Saturation (%)	8.28±17.33	10.43±11.50	0.011

(20.2%) had paleness, 13 (17.6%) had headache, 9 (12.2%) had palpitation, 6 (8.1%) had GI bleeding (hematemesis and/or melena), 2 (2.7%) had forgetfulness, and 2 (2.7%) had growth retardation.

Breast milk and/or formula milk intake history and pica histroy of patients were questioned. Red meat, legumes and molasses consumption were questioned and classified (Table 1). There was no significant difference between genders in terms of breastfeeding and formula feeding (p=0.379, p=0.350). All the patients with pica history were diagnosed with IDA. However, there was no significant relationship between pika history and IDA (p=0.179). There was no significant difference in the frequency of consumption of red meat, molasses and legumes among the genders (p=0.274, p=0.557, p=0.095). The relationship between laboratory findings of patients and consumption of red meat, molasses and legumes was evaluated (Table-2,3,4).

Patients' chronic disease presence, recent infection status, bleeding history (GIS and

Table-5: Presence of chronic diseases, recent infection status, bleeding history (GIS and menorrhagia) results

		n	%
Hronic disease history	Absent	53	71.6
	Present	21	28.4
Enfeksiyon durumu	Absent	64	86.5
	Present	10	13.5
Gastrointestinal kanama	Absent	68	91.9
	Present	6	8.1
Menstruation	Daily >8 pads	13	23.6
	Daily <8 pads	32	58.2
	No menstrual cycle	10	18.2

Table-3: The relationship between molasses consumption and anemia

	Molasses Consumption		p
	Less	Frequent	
	Mean±Standard Deviation	Mean±Standard Deviation	
Hemoglobin (gr/dl)	7.75±2.25	8.97±2.35	0.026
Hematocrit (%)	25.92±6.35	28.38±6.72	0.112
Erithrocyte Count (/mm^3)	4.06±1.01	3.87±0.93	0.415
MCV (fL)	66.25±15.46	74.60±12.04	0.014
RDW (%)	20.92±5.80	18.02±3.59	0.015
Leukocyte Count (/mm^3)	7527±2329	9700±9920	0.612
Neutrophil Count (/mm^3)	4500±2072	5060±3506	0.398
Thrombocyte Count (/mm^3)	317238±153274	252531±125606	0.056
Reticulocyte (%)	1.10±0.63	1.08±0.99	0.262
Iron (ug/dl)	29.48±37.38	42.39±32.86	0.005
Iron Binding Capacity (ug/dl)	449.74±93.29	422.37±102.04	0.242
Ferritin (ng/ml)	40.07±133.89	29.78±57.47	0.012
Transferrin Saturation (%)	8.05±15.79	11.38±12.17	0.011

Tablo-4: The relationship between legumes consumption and anemi

	Legumes Consumption		p
	Less	Frequent	
	Mean±Standard Deviation	Mean±Standard Deviation	
Hemoglobin (gr/dl)	7.85±2.71	8.62±2.01	0.161
Hematocrit (%)	25.94±7.68	27.82±5.50	0.223
Erithrocyte Count (/mm^3)	3.96±1.18	3.99±0.80	0.882
MCV (fL)	68.47±17.69	70.99±11.64	0.464
RDW (%)	20.82±6.46	18.73±3.58	0.082
Leukocyte Count (/mm^3)	7825±2382	8983±8878	0.249
Neutrophil Count (/mm^3)	4592±2238	4866±3169	0.680
Thrombocyte Count (/mm^3)	319455±166118	264951±121549	0.108
Reticulocyte (%)	1.18±0.73	1.01±0.84	0.278
Iron (ug/dl)	35.31±42.77	34.68±29.57	0.421
Iron Binding Capacity (ug/dl)	431.03±98.18	444.51±97.36	0.562
Ferritin (ng/ml)	49.67±150.02	24.18±51.65	0.263
Transferrin Saturation (%)	10.16±17.76	8.84±11.00	0.887

Table-6: Examination of total blood counts and iron parameters of patients

	Mean±Standard Deviation	Min. value	Max. value
Hemoglobin (gr/dl)	8.3±2.4	1	12
Hematocrit (%)	27.0±6.6	5	37
Erithrocyte Count (/mm^3)	4.0±1.0	0.3	6
MCV	69.9±14.6	49	144
RDW	19.7±5.1	13	40
Leukocyte Count (/mm^3)	8467±6783	2560	45600
Neutrophil Count (/mm^3)	4745±2785	580	17000
Thrombocyte Count (/mm^3)	289257±144693	9000	812000
Iron (ug/dl)	35.0±35.9	8	214
Iron Binding Capacity (ug/dl)	438.3±97.3	214	655
Ferritin (ng/ml)	35.7±107.8	1	748
Transferrin saturation (%)	9.4±14.4	1	99

menorrhagia) were questioned (Table-5).

Detailed physical examinations of the patients were performed at the time of application. Pathological physical examination findings were absent in 21 patients (28.4%) and present in 53 patients (71.6%). Anthropometric measurements of the patients were performed and weight percentile of 17 (23%), and hegiht percentile of 9 (12.2%) were less than 3% percentile. The mean BMI was found as 19.7±3.5 (min:10 max:27). The number of patients whose BMI was less than 18 kg/m^2 was 22 (29.7%). Fifteen (27.2%) of the girls and 7 (36.8%) of the males were below this limit. In 17 of 60 patients with IDA, BMI was found to be below 18 kg/m^2, whereas in patients with IDA, there was no significant difference in BMI, whether it is low or high (p=0.296). However, in the majority of patients with Vitamin B12 deficiency (6 out of 9 patients) the BMI was found to be below 18 kg/m^2 (p=0.010).

Complete blood count (CBC), iron, TIBC and ferritin levels of patients were studied (Table 6). Mean values, standard deviations, minimum and maximum values were found. Reticulocyte counts were measured in 68 of our patients whom we evaluated etiologically, and reticulocytosis was detected in 24 (35.2%) (corrected reticulocyte >1%). Direct coombs test was negative in 69 (95.8%) of 72 patients. Of the 3 patients in whom the test was positive, 2 had IDA and 1 had autoimmune hemolytic anemia (AIHA).

When the peripheral smears of the patients were evaluated, hypochromia was detected in erythrocyte morphology in 52 patients (70.3%). There were also anisocytosis in 36 patients (48.6%), microcytosis in 8 (10.8%), pochylocytosis in 4 (5.4%), macrocytosis in 2 (2.7%) and spherocytosis in 2 (2.7%). In 15 of the patients (20.3%), erythrocytes were seen as normochromic, and in 11 (14.9%), as normocytic. Cells were seen in the structure of blast in three patients.

Table-7: Diagnostic evaluation of anemias

Diagnoses	n	%
Iron Deficiency Anemia	60	81
B12 Deficiency	10	13.5
Gastrointestinal Bleeding	6	8.1
Sepsis	3	4.1
Acute Leukemia	3	4.1
Autoimmune Hemolitic Anemia	1	1.4
Folic Acid Deficiency	1	1.4
Aplastic Anemia	1	1.4
Hereditary Spherocytosis	1	1.4
Chronic Renal Failure	1	1.4
Autoimmune Hepatitis	1	1.4
Cholangitis	1	1.4

As a result of the examinations, the most frequent was IDA in patients (Table 7). The relationship between gender and IDA was statistically analyzed. Forty-eight (87.2%) of the 55 female patients were diagnosed as IDA, compared to 12 of the 19 male patients (63.1%). The prevalence of IDA in females was significantly higher than in males (p=0.021).

We investigated the vitamin B12 deficiency and folic acid deficiency which are the important causes of megaloblastic anemia in adolescence. B12 deficiency was detected in 10 of the patients (13.5%), whereas folic acid deficiency was detected in 1 (1.4%). Eight of 10 patients with Vitamin B12 deficiency were accompanied by IDA.

ESR and CRP values were analyzed from infectious indicators of patients. The mean ESR level was 15.3±15.9 (min:2, max:69) and the CRP level was

19±47.5 (min:0, max:271). As a result of these values and physical examination, sepsis was diagnosed in 3 patients. No other reason was found to explain the anemia of these 3 patients.

Because of GI bleeding may cause anemia and IDA in adolescence, FOBT, stool parasite and stool H. pylori antigen tests were performed. In selected patients, gastrointestinal endoscopy (gastroscopy and colonoscopy) was performed to investigate these diseases. Fecal occult blood was investigated in 72 patients and it was found negative in 64 (86.5%) and positive in 8 (10.8%). FOBT positivity was found in 5 out of 60 patients diagnosed with IDA and in 2 out of 12 patients without IDA diagnosis and there was no statistically significant correlation between FOBT and IDA (p=0.374). In 54 (73%) of the patients stool parasites were investigated and only 2 had (3.7%) parasites. In 50 out of 60 patients diagnosed with IDA, stool parasite was investigated and was not found significantly in patients who had a diagnosis of IDA (p=0.290). Stool H. pylori antigen was found negative in 40 (78.5%) of 51 patients and positive in 11 (21.5%). Of 44 patients who were diagnosed with IDA, H. pylori antigens were positive in 11 (25%) for the antigen and 33 (75%) were negative. Stool H. pylori antigen positivity did not show a significant elevation in patients with IDA diagnosis (p=0.055).

Endoscopy (1 patient had colonoscopy, 10 patients had gastroscopy) was performed and biopsy was taken in 11 patients who were admitted with a GIS bleeding complaint, who were FOBT positive, stool H. pylori antigen positive and did not respond to oral iron therapy. The examinations revealed gastritis in 4 patients, gastritis and duodenitis in 3 patients, duodenitis in 1 patient, gastric ulcer in 1 patient, esophagitis in 1 patient and IBD in 1 patient.

Patients were treated relevantly to the diagnosis they received. Twenty-nine patients (39.2%) were hospitalized and 45 (60.8%) were followed-up outpatiently and treated. Patients hospitalized received IDA, 3 had acute leukemia, 3 had sepsis, 1 had anaplastic anemia, 2 had gastrointestinal bleeding, 1 had AIHA, 1 had autoimmune hepatitis, and 1 had B12 deficiency diagnosis. Ten of the patients who were hospitalized (13.5%) were transfused with erythrocyte suspensions due to the detection of deep anemia (Hb: 7gr/dl) or symptomatic anemia (heart failure, systolic murmur, tachycardia, exertional dyspnea, gallop rhythm, hepatomegaly development). Parenteral iron therapy was administered to 23 (31.1%) of the patients who had iron deficiency anemia. Special treatments have been applied according to the characteristics of the diseases; aplastic anemia, AIHA, hereditary spherocytosis, leukemia, sepsis, CRF, autoimmune hepatitis and cholangitis. Oral and/or parenteral vitamin B12 supplementation was given to patients with B12 deficiency. The patient with folic acid deficiency was given oral folic acid.

DISCUSSION

Anemia is defined as a decrease in erythrocyte volume or a lower Hb concentration value than in healthy humans (6). The prevalence of anemia in our country is 1.5-12.5% and the adolescence is accepted as a risky age group for anemia (8). In this period, the cause of anemia is usually nutritional, however, chronic diseases, malignancies, digestive system lesions, parasitic infections and other infectious conditions can also cause anemia (9).

Anemia in adolescence is often seen in female gender. Ferrari et al. (10) evaluated the European adolescents in a study conducted in 2011 and examined a total of 940 children aged between 12.5-14.9 years from 10 european cities. The prevalence of anemia was found as 4.2% and 27.5% of patients with anemia were diagnosed with IDA. Serum ferritin levels of the females were found to be significantly lower than that of males, and this was linked to menorrhagia. We couldn't measure prevalence because we have studied patients who had only anemia in our study. We tried to determine etiological research and risk factors in cases of anemia. Our study supports other studies in terms of gender, and the female gender ratio (74.3%) was significantly higher than that of males. IDA was the most common cause of anemia in our study and was found to be higher in females than in males. This result is similar to the other studies' results and we found that there was no significant difference between genders in terms of consumption of red meat, legume and molasses, consumption of breast milk and

formula, and IDA in girls was associated with blood loss from menorrhagia.

Pika is a behavioral disorder characterized by regular and extreme consuming of a non-nutritious substance or food. It is especially common in children between the ages of 1 and 3, in pregnant women, in black women and in individuals with mental retardation. Iron Deficiency Anemia is also seen in high rated in these cases (11). In our study, all patients with pica history were diagnosed with IDA. However, there was no significant relationship between pica story and IDA (p=0.179). This outcome was attributed to the fact that the study group was not covering the age group and characteristics of the population, which pica is seen frequently.

Bhardwaj et al. (12) performed a cross-sectional study with 885 adolescents aged between 11-19 years in India in 2010, and a relationship between anemia frequency and iron, B12 and folate levels was investigated. Anemia was detected in 96.7% of females and in 87.2% of males and was avelauted as significantly higher in females. The cause of anemia was found to be highly IDA, and the levels of Hb and ferritin were found to be significantly lower in females than males. The rate of patients with low BMI was found to be 68.9%. No difference between boys and girls was detected. In our study, we found this rate as 29.7%. We did not find any difference between genders in terms of BMI.

The relationship between anemia and nutrition was investigated by Balcı et al. (13) in 2012 in Denizli, between children aged 12-16 years, and anemia was detected in 8.3% of the females and 1.6% of the males. The higher prevalence of anemia in females compared to males is linked to menstrual irregularities and malnutrition due to weight gain concerns. The relationship between consumption of red meat, legume and molasses and anemia, in which iron content is high was evaluated, in addition to the information that the one of the most common reasons for iron deficiency anemia is nutritional. We found low levels of Hb, hematocrit, serum iron and ferritin, which are indicative of IDA in patients with low consumption of red meat, and the incidence of IDA was high in this group. Hb, MCV, serum iron and ferritin values were significantly lower and RDW was significantly higher in the group with low molasses consumption, another nutrient with high iron content. Legume consumption did not show any difference in terms of anemia indicators. These findings are similar to the findings of the study by Balcı et al., which was conducted in Denizli province, where the consumption of red meat is low, and consumption of fresh vegetables and fruit is high, indicating the importance of nutrition on IDA.

Vitamin B12 deficiency and folic acid deficiency are among the causes of anemia in adolescence and are often nutritional. The only source of vitamin B12 is animal products. Folic acid is found in fresh vegetables and fruits. Studies on Vitamin B12 and folic acid deficiency in adolescence are limited for Turkey (8). Balcı et al. (13) in their study, found no folic acid deficiency, and B12 deficiency was detected with a rate of 41%. In addition, deficiency of B12 was accompanied by IDA with a rate of 100%. B12 and iron deficiency were linked to the low consumption of animal products and the absence of folic acid deficiency, to the frequent consumption of fresh vegetables and fruits. It is emphasized that this traditional eating habits lead to an increase in anemia prevalence. In a study conducted by Öncel et al. (14) in 2006 at schools in the province of Diyarbakır city center, 889 children aged between 12-22 years were investigated for vitamin B12 deficiency and folic acid deficiency and found that 2.2% of patients had deficiency of Vitamin B12 and 21.8% had folic acid deficiency. This result has been attributed to unbalanced and undernutrition, low socioeconomic status, and it has been emphasized that vitamin deficiencies should be considered in the etiology of anemia. In our study, vitamin B12 deficiency was detected in 13.5%. 80% of these patients were accompanied by IDA. Folic acid deficiency was found in 1.4% of patients. Our findings suggest that although rare, vitamin B12 deficiency and folic acid deficiency should be considered in the etiology of anemia of adolescents.

George et al. (15) in 2012, investigated hemoglobinopathies in Cambodia in patients between 6-59 months old and found it as 58%. It is emphasized that hemoglobinopathies are among frequent causes of anemia. In our study, 1.4%

hereditary spherocytosis and 1.4% AIHA were observed. Hemolytic anemias may be the cause of anemia in childhood, but sickle-cell anemia, hereditary spherocytosis and AIHA can rarely be detected in adolescence, although most of them present with signs in the early childhood. The reason that we found this rate low in our country where hemoglobinopathies are frequent is thought to be that these patients are diagnosed at an early age and rarely encountered during adolescence.

Acute and/or chronic loss from the gastrointestinal tract leads to anemia. Chronic losses such as esophagitis, gastritis, duodenitis, ulcer and IBD are important causes of IDA (6). When these diseases are suspected in the etiology of anemia, FOBT and GIS endoscopy may be necessary. In the study by Kawakami et al. (16) conducted in 2004, in 43 children between 4 months and 17 years old who had dyspepsia complaints and were examined with upper GIS endoscopy, were found to have gastritis, ulcer and duodenitis in 92%, 79.1% and 20.9%, respectively. 48.8% of these patients were anemic and it was emphasized that these diseases should be investigated in etiology in all childhood period, especially in adolescence period. We performed an upper GI endoscopy to patients with anemia, with accompanying bleeding or dyspeptic complaints, FOBT positivity and who were unresponsive to oral iron therapy. Of the 10 patients, 4 received gastritis, 3 gastritis and duodenitis, 1 duodenitis, 1 ulcer, 1 esophagitis diagnosis. One patient with rectal bleeding and anemia was diagnosed as IBD by colonoscopy. Acid peptic diseases and IBD can be detected in adolescents with signs and symptoms of GIS disorders and anemia.

The relationship between anemia and H. pylori infection has been investigated in some studies. In a meta-analysis carried out by Qu et al. (17) in 2010, 15 studies on H. pylori infection and IDA were investigated and it was found in most of the studies that there was a significant correlation between H. pylori and IDA. Duque et al. (18) in their study which was conducted with 718 school children in Mexico in 2012, founf the prevalence of H. pylori infection as 38% and indicated that the this rate increases in cases with IDA. Süoğlu et al. (19) in their study involving 70 patients aged between 4-16 years in 2007, investigated the relationship between IDA and gastroduodenal disease in Turkish children and foundserum iron and ferritin levels higher in H. pylori infection-free patients. We investigated the stool H. pylori antigen and evaluated its relationship with IDA. H. pylori antigen positivity was detected in 21.5% of the 51 patients in which the test was performed and 4 patients were diagnosed with H. pylori infection after endoscopic biopsy. As a result of the statistics, H. pylori positivity was not found to be significantly high in IDA. This result was not comparable with the results of other studies and suggested that IDA might be due to nutritional reasons for the patient population we investigated.

Parasitosis can lead to resistant anemia, especially in underdeveloped and developing countries. George et al. (15) in their study in Cambodia, examined 3124 patients between 6 and 59 months of age for the etiology of anemia, and 54% of them were found to have helminth infection, suggesting that anemia is a more important determinant criteria than eosinophilia in these patients. In a study conducted by Ramzi et al. (20) in which they investigated anemia in adolescents in 2011, 363 patients were evaluated and they observed parasitic infection more common in the rural area. It has been shown that the frequency of anemia is 6.83 times higher in patients with a history of parasitic infections in the past 3 months. It has been emphasized that parasitic infestation is an important risk for anemia and should be prevented. We conducted an investigation for parasites in 73% of our patients and found a positivity rate of 3.1%. The incidence of parasitic infections was low and parasitic infection rates were not significantly high in patients with diagnosis of IDA. Unlike other studies, we thought that this is due to the fact that our patients live in the cities and the cause of IDA is often nutritional.

Although normal peripheral blood levels can be detected with a rate of 20% at the time of initial diagnosis in acute leukemia, anemia is the most common and the earliest laboratory finding (21). In our study, 3 patients who presented with anemia had acute leukemia. When all anemia types are considered, the rate of malignancy is low, but it should be kept in mind in the etiology of anemia, in

patients with no response to treatment or who have admitted with deep anemia findings, with additional laboratory pathologies.

Although our study included adolescents admitted to a pediatric outpatient clinic in approximately 18 months with anemia, diagnosed at the end of the screening tests, our number of patients was limited to 74. This study may be considered to be performed with a larger number of patients in order to strengthen the link between adolescent anemia and nutrition. Another weak point of this study is that no questioning has been performed in order to exclude the interaction of nutrients (red meat, molasses and legumes) with other foods and possible medicines while the relationship between anemia and nutrition was being examined. These facts can be taken into consideration during the next planning of a similar study.

As a result; anemia, which is a sign of inadequate nutrition in our country where the adolescent age group constitutes a significant part of the population, is a serious public health issue for this age group. It is important to understand better and evaluate anemia in this period when growth is accelerated and cognitive functions become more important. In this age group, health care follow-ups should be done regularly and health problems should be detected earlier and the cause-oriented research should be performed. We investigated the causes of anemia during adolescence in our study and found that for this age group that unhealthy diet is an important cause of anemia. In our country where the anemia is still a major health problem, more multicentered studies involving greater number of patients to investigate the aetiology of anemia in adolescence are required.

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