

The Investigation of Some Hematological Values and Anemia Prevalence in Adult Population of Tokat Province

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ABSTRACT

This study was conducted in 70 (12 urban and 58 rural) settlements in Tokat province. The study group consists of a random sampling of 1095 participants aged 18 years and over. A questionnaire was administered to and blood samples were taken and analyzed from all individuals involved in the study group. Hemoglobin, hematocrit, erythrocyte, Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and leukocyte values were significantly lower in female participants. Red Cell Distribution Width (RDW) and thrombocyte values were significantly lower in male participants. Anemia prevalence was found to be 11.1% in the study group and anemia was more commonly found in females (15.9%) than males (6.1%). In addition, anemia prevalence was reached highest level in the 60 aged and over. More than half of anemic individuals (51.2%) had microcytic, 45.5% normocytic, and 3.3% macrocytic anemia. In this study, hematological values in Tokat province were found to be lower than the results of studies performed in other areas of Turkey. We hypothesize that the difference may be related to the higher altitude of Tokat province. Also, Tokat's lower anemia prevalence may be related to the nutritional habits and lifestyle of its inhabitants.

Key Words: Anemia prevalence, Hemoglobin, Hematological values, Tokat

ÖZET

Tokat Bölgesinde Erişkin Nüfusta Anemi Prevalansı ve Bazı Hematolojik Değerlerin İncelenmesi

Bu çalışmada Tokat ili kırsal ve kentsel yerleşim yerlerinde yaşayan 18 yaş ve üzeri erişkin nüfusta bazı hematolojik değerler ve anemi prevalansının ortaya konulması amaçlanmıştır.

Bu çalışma Tokat bölgesinde 70 (12 kentsel ve 58 kırsal) yerleşim alanında yapılmıştır. Çalışma grubu random örnekleme yöntemleri ile seçilmiş 18 yaş ve üzeri 1095 kişiden oluşmaktadır. Çalışma grubunda yer alan kişilere anket uygulanmış ve kan örnekleri alınarak analiz edilmiştir.

Hemoglobin, hematokrit, eritrosit, MCV, MCH, lökosit değerleri kadınlarda, RDW ve trombosit değerleri erkeklerde anlamlı derecede düşüktü. Çalışma grubunda anemi sıklığı %11.1 bulundu. Anemi sıklığı kadınlarda (%15.9) erkeklerle (%6.1) göre daha yüksekti. Ayrıca, anemi sıklığı 60 yaş ve üzeri grupta en yüksek düzeye (%16.9) ulaşmaktaydı. Anemik vakaların yarısından fazlası (%51.2) mikrositer, %45.5'i normositer, %3.3'ü ise makrositer tipte idi.

Tokat bölgesinde yapılan bu çalışmada hematolojik değerler Türkiye'de yapılmış diğer araştırma verilerinden düşüktür. Bu farklılık Tokat bölgesi rakımı ile ilgili olabilir. Anemi sıklığı da Türkiye'nin diğer bölgelerine göre düşük bulunmuş olup bu durum halkın beslenme alışkanlıkları ve yaşam biçimlerinden kaynaklanıyor olabilir.

Anahtar Kelimeler: Anemi sıklığı, Hemoglobin, Hematolojik değerler, Tokat

INTRODUCTION

Anemia is a global public health problem that affects both developed and developing countries and can be seen in any period of human life. Moreover, it causes economic and social problems.¹ The World Health Organization (WHO) claims that the serum hemoglobin concentration should be below 13 mg/dl in males and 12 mg/dl in females and serum hematocrit should be below 39% in males and below 36% in females for a good diagnosis of anemia.² Normal values of hematological parameters can vary in relation to age, gender, ethnicity, geographic region, and socio-cultural factors.³ Anemia prevalence may be related to general nutrition, economic status, and basic level of health service.⁴ According to data provided by WHO, over 2 billion people are anemic worldwide.⁵ The anemia prevalence in developing countries is higher than the developed countries. While this rate is 14% in European countries, it is 25% in Turkey.⁶ According to Turkish studies and others performed the world over, the anemia prevalence is higher especially in preschool age children, pregnant women, and the elderly.^{1,3,7}

Hematological values are associated with gender, age, ethnicity, nutritional habits, and some features of geographic region such as temperature and elevation.^{3,7,8} Analyzing these differences can facilitate the diagnosis and treatment of some diseases, such as anemia.⁸

This study aimed to detect the distribution of hematological parameters and prevalence of anemia in the adult population in Tokat city, located in the middle-Black Sea region at an elevation of 623 meters. Study data were compared with other research data performed in other provinces of Turkey and the other countries. Furthermore, the anemia prevalence in Tokat was quantified and related factors affecting the prevalence of anemia were evaluated.

MATERIALS AND METHODS

This study utilized data originating from a 2005 study entitled "Prevalences of the diseases which are frequently faced especially in Tokat province." The study sampling consisted of 1,095 participants over the age of 18 residing in both rural (58 areas) and urban (12 areas) parts of Tokat province where the adult population is nearly 530,000. Cluster

sampling was used to determine the studied areas and individuals were selected by stratified sampling according to age groups and gender.

A signed informed consent was acquired from all the participants, and prior to the study an ethical agreement was validated by the Ethical Committee of the Faculty of Medicine, Gaziosmanpaşa University.

Blood samples were taken from the participants at least 8 hours after eating and were analyzed in the same day. For the diagnosis of anemia a hemoglobin concentration below 13 mg/dl in males and below 12 mg/dl in females was necessary.²

All data are shown with their arithmetical mean and standard deviation values. The differences between the groups were analyzed by Chi square test and student-t test. Significance level was accepted as $p < 0.05$.

RESULTS

Five hundred forty-one (49.4%) out of 1,095 participants were males, 554 (50.6%) out of 1,095 were females. The age in males was 41.2 ± 17.7 and 41.6 ± 16.2 in females. 555 out of 1,095 (50.7%) were living in urban areas, whereas 540 (49.3%) were living in rural areas. There was no significant difference between sexes according to the age groups (Table 1).

The hematological values of the participants are presented (Table 2). Hemoglobin, hematocrit, erythrocyte, Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and leukocyte values were significantly lower in females than in males. Conversely, Red Cell Distribution Width (RDW) and thrombocyte values were significantly lower in males than females.

The anemia prevalence was found to be 11.1% in 1,095 participants. While this rate is 6.1% in males, it was 15.9% in females. Anemia prevalence in females was very high (Table 3). By age group, the anemia prevalence was significantly different and the prevalence reached the highest level (19.9%) in participants over 60 years of age.

Findings showed anemia prevalence was 10.3% in urban areas and 11.9% in rural areas ($p > 0.05$). Anemia prevalence was the lowest at 5.1% in areas with the highest level of income, but there was no

Table 1. The distribution of the sample to age and gender groups

Age Group	Male		Female		Total	
	n	%	n	%	n	%
18-29	185	54.4	155	45.6	340	100
30-39	105	44.1	133	55.9	238	100
40-49	82	47.4	91	52.6	173	100
50-59	62	43.4	81	56.6	143	100
60+	107	53.2	94	46.8	201	100
Total	541	49.4	554	50.6	1.095	100

significant difference among income levels. Anemia prevalence was observed as significantly high in housewives (16.7%). In divorced participants the anemia prevalence, at 20.3%, was significantly higher than married and single participants.

Anemia prevalence was found to be at the lowest level in males aged 18-49 (3.0%) and at the highest level in those aged 60 and above (18.7%) ($p < 0.0001$) (Table 4).

The highest level of anemia prevalence in females was the 30-39 age groups (24.1%). In the fertile period of the females (18-49 age groups) anemia pre-

valence was 17%. In females the anemia prevalence is higher in all age groups except for those 60 years of age and older. However, there was no overall significant difference in anemia prevalence in females by age group when compared to males.

The relationship between hematological data and anemia, and hemoglobin, hematocrit, MCV, MCH, and leukocyte values were significantly low according to the anemic group (Table 5), whereas RDW and thrombocyte values were significantly higher in the anemic group. At 51.2%, nearly half of anemic cases were microcytic, 45.5% were normocytic, and 3.3% were macrocytic.

Table 2. The distribution of hematological values to genders

	Male (n: 541)	Female (n: 554)	Total (n: 1.095)
Hemoglobin (g/L)*	15.2±1.7	13.1±1.4	14.2±1.7
Hematocrit (%)*	44.7±4.5	39.4±3.6	42.0±4.9
Eritrocyte ($\times 10^{12}/L$)*	5.1±0.5	4.6±1.3	4.8±1.0
MCV*			
Microcytic (<80 fl) %	4.8	15.7	10.3
Normocytic (80-100 fl) %	93.0	83.6	88.2
Makrocytic (>100 fl) %	2.2	0.7	1.5
MCH (pg)*	29.9±2.3	28.7±2.7	29.3±2.6
RDW (*)	13.1±1.0	13.5±1.3	13.3±1.2
Leukocyte ($10^9/L$)*	7.7±2.0	7.2±2.0	7.4±2.0
Thrombocyte ($10^9/L$)*	263.8±64.7	293.0±70.8	278.6±69.3

* $p < 0.0001$

Table 3. The relationships of socio-demographic features with anemia

	Anemia		No anemia		Total		p
	n	%	n	%	n	%	
Gender							<0.001
male	33	6.1	508	93.9	541	100	
female	88	15.9	466	84.1	554	100	
Age groups							0.001
18-29	23	6.8	317	93.2	340	100	
30-39	35	14.7	203	85.3	238	100	
40-49	16	9.2	157	90.8	173	100	
50-59	13	9.1	130	90.9	143	100	
60+	34	16.9	167	83.1	201	100	
Habitat locality							0.4
urban	57	10.3	498	89.7	555	100	
rural	64	11.9	476	88.1	540	100	
Monthly income of the family							0.3
≤ minimum wage (MW)	40	10.4	338	89.6	378	100	
MW – 2 x MW	36	10.6	305	89.4	341	100	
2 x MW – 4 x MW	42	13.2	275	86.8	317	100	
≥ 4 x AU	3	5.1	56	94.9	59	100	
Job / profession							<0.001
retired	8	10.0	72	90.0	80	100	
worker	2	8.0	23	92.0	25	100	
farmer	17	7.1	224	92.8	241	100	
officer	0	0	49	100	49	100	
freelance profession	5	6.8	69	93.2	74	100	
artisan	0	0	47	100	47	100	
student	2	3.4	57	96.6	59	100	
hosewife	87	16.7	433	83.3	520	100	
Marital status							0.01
single	13	6.6	184	93.4	197	100	
married	96	11.4	743	86.4	839	100	
Widowed- widower	12	20.3	47	79.7	59	100	
Total	121	11.1	974	88.9	1.095	100	

Microcytic anemia in females was observed as higher, whereas macrocytic anemia was not observed in female anemic groups at all. Microcytic anemia cases decreased in females and increased in males in the 60 and over age groups. In addition, 75% of macrocytic anemia cases were found in males over the age 60 (Table 6).

DISCUSSION

Hematological parameters can vary in different societies and in different parts of those societies. Considering these differences may provide for a more proper evaluation of hematological values and subsequent clinical approach.^{3,8} In addition, it is important to know the normal hematological values of

Table 4. Distribution of the presence of anemia according to age groups and genders

		Anemia		No anemia		Total		p
		n= 121 (%11.1)		n= 974 (%88.9)		n= 1.095		
		n	%	n	%	n	%	
Male	18-29	5	2.7	180	97.3	185	34.2	< 0.001
	30-39	3	2.9	102	97.1	105	19.4	
	40-49	3	3.7	79	96.3	82	15.2	
	50-59	2	3.2	60	96.8	62	11.5	
	60+	20	18.7	87	81.3	107	19.8	
Total		33	6.1	508	93.9	541	100.0	
Female	18-29	18	11.6	137	88.4	155	28.0	0.07
	30-39	32	24.1	101	75.9	101	24.0	
	40-49	13	14.3	78	85.7	91	16.4	
	50-59	11	13.6	70	86.4	81	14.6	
	60+	14	14.9	80	85.1	94	17.0	
Total		88	15.9	466	84.1	554		

different regions while evaluating the blood results in a clinical setting.

The hematological parameters of 1.095 adult participants of varying genders and age groups living in 70 regions, representing the whole of Tokat, were analyzed in this study. Mean values of hematological parameters were compared first on the basis of gender. Initial analysis uncovered significant differences in mean hematological values of males and females. Likewise, similar hematological differences predicated by gender have been found in the other studies carried out by Kaya et al. in Erzurum and Yılmaz et al. in Sivas.^{7,8} In those studies, males showed significantly higher values in the hematocrit, erythrocyte, MCV, MCH, and leukocyte means in comparison to females of similar age. Similarly, many studies performed in healthy adults reported that males have higher hematological values than females.^{3,4,7-11}

The values of hemoglobin, hematocrit, and erythrocyte in the studies by Kaya and Yılmaz were higher than our study results.^{7,8} It was reported that values of hemoglobin, hematocrit, and entrosit become significantly high when elevation of the region is above sea level.^{12,13} The present study results fit

with the literature due to the higher elevation of Erzurum and Sivas (respectively, 1869 m-1285 m.) than Tokat (623 m.).

Anemia prevalence, as found in our study, was 11.1%. This value is higher than the anemia prevalence declared by WHO for the whole of Turkey at 25%.⁶ However, the anemia prevalence, in the present study, is lower than other Turkish studies. The anemia prevalence was 38.1%, for people living in mountainous parts of Isparta (4) and 15.9% in Van province.³ In those studies several factors, such as economic, social, and cultural distinctive to a particular regions or people affect anemia prevalence.^{3,4}

Anemia prevalence was higher in females than males in the present study. Many studies performed in the Turkish adult population, except for those 60 years of age and older, have shown anemia prevalence to be higher in females than males.³ Anemia prevalence was reported to be very high in females in comparison to males (respectively; 48.4, 34.0) in the study of Kisioglu et al.⁴ In the U.S.A., the prevalence on anemia was found to be 2.7% in the 18-24 age group, 2.9% in 25-44 age group, and 3.8% in 45-64 age group in males; however, in females it was 3.3%, 5.8%, and 3.9%, respectively.¹⁴ These re-

Table 5. The relationships of hematological values with anemia

	Anemia n= 121 (% 11.1)	No anemia n= 974 (%88.9)	Total n= 1.095
Hemoglobin g/L*	11.2 ± 1.2	14.5 ± 1.4	14.2 ± 1.7
Hematocrit %*	35.2 ± 3.3	42.9 ± 4.3	42.0 ± 4.9
Eritrocyte x10 ¹² /L*	4.7 ± 2.7	4.9 ± 0.5	4.8 ± 1.0
MCV fl*			
Microcytic (<80 fl) %	51.2	5.2	10.3
Normocytic (80-100 fl) %	45.5	93.6	88.2
Macrocytic (>100 fl) %	3.3	1.2	1.5
MCH pg*	25.5 ± 4.1	29.7 ± 1.8	29.3 ± 2.6
RDW %*	15.4 ± 1.8	13.1 ± 0.8	13.3 ± 1.2
Leukocyte 10 ⁹ /L*	6.8 ± 1.9	7.5 ± 2.0	7.4 ± 2.0
Thrombocyte 10 ⁹ /L*	291.2 ± 86.6	276.9 ± 66.7	278.6 ± 69.3

* p < 0.01

sults are much lower than both our study and other Turkish studies cited in our research.

While the anemia prevalence was 3% in males, it was 16.6% in females in the 18-49 age group. However, the WHO declared the overall anemia prevalence for Turkey in the 15-49 age group females as 26.3%.¹ Many research results showed this age group was at risk for anemia both in our country and in other developing countries. The anemia prevalence in the same age group for females was 45.2% in the studies performed by Kişioğlu et al. and 33.7% by Aktekin et al.^{4,15}

In our study, anemia prevalence was not associated with a rural or urban lifestyle or income level of participants. However, it was seen that profession is a correlative factor in anemia prevalence. Detailed data analyses showed the highest anemia prevalence to be in housewives and the retired. 70% of housewives were in the 18-49 age group and 51.9% of the retired group was males over 60 years old. Similarly, anemia prevalence was found to be very high in widows as 66.1% of these people are over 60. Moreover, anemia prevalence was found almost twice as often in married people in comparison to those who were single. In detailed analysis, 57.3%

of married people found to have anemia were in the 18-49 age group, which showed a high risk for female; anemia prevalence in single people was found to half as common.

Another important result we found is that anemia prevalence is at its highest (16.9%) in those 60 years old and older. Similarly, anemia in the elderly was found to be high in many studies, like Kişioğlu et al. who reported 31.5% in study participants 50 years of age and older, and Coban et al. who reported a prevalence rate of 25% and 30.5% in participants over 65 years of age.^{4,16,17} However, in other international studies participants in the same age group had a prevalence rate of 31.4% in Israel and 24.0% in Belgium.^{18,19} The results of these studies are higher than our results where the anemia prevalence in over 60 age group was recorded as 18.7% in males and 14.9% in females. Moreover, anemia prevalence was found to be significantly higher in this age group than other age groups. Similar results were found in other studies performed both in Turkey and in other countries where anemia prevalence was higher in males than females. Kişioğlu et al. found an anemia prevalence of 15.6% in females and 57.4% in males over 50 years of age.⁴

Table 6. Distribution of MCV values according to gender and age groups in anemic group

Gender*	Age group	Anemia (n= 121)						Total	
		Microcytic <80 fl		Normocytic 80-100 fl		Macrocytic >100 fl		n	%
		n	%	n	%	n	%		
Male	18-29	3	21.4	1	6.7	1	25.0	5	15.2
	30-39	3	21.40	0	0.0	0	0.0	3	9.1
	40-49	1	7.1	2	13.3	0	0.0	3	9.1
	50-59	2	14.3	0	0.0	0	0.0	2	6.1
	60+	5	35.7	12	80.0	3	75.0	20	60.5
	Total	14	42.4	15	45.5	4	12.1	33	100.0
Female	18-29	11	22.9	7	17.5	0	0	18	20.5
	30-39	17	35.4	15	37.5	0	0	32	36.4
	40-49	7	14.6	6	15.0	0	0	13	14.7
	50-59	9	18.8	2	5.0	0	0	11	12.5
	60+	4	8.3	10	25.0	0	0	14	15.9
	Total	48	54.50	40	45.5	0	0	88	100.0

Several reports on the anemia prevalence conflict with these such as 15.2% in the males and 12.6% in females who are 71 years of age and over by Saliva et al., 17.7% in males and 8.4% in females who are over 60 years of age or older by Timiras and et al., 9% in the males and 6.9% in females 60 years of age and older by Ania and his friends, and 4.4% in males and 3.9% in females in the 60-74 age range by Dallman et al.^{14,20-22} Each of the previous studies reports of older age groups shows anemia to be more prevalent in males than in females.

In developing countries children below the age of 5 and females in the 15-49 age range are considered as risk groups in studies for detecting anemia.²³ Due to a higher anemia rate in older people, physicians should be more careful in their clinical evaluations. Anemia in the older age group should not be considered a normal part of aging, but should be diagnosed and treated as a potentially dangerous health issue. Subsequently, proper diagnosis and treatment of anemia in the elderly can increase quality of life and life span.¹⁷

Studies have identified iron deficiency to be the main cause of anemia, especially when seen in ol-

der males and post-menopausal females. Gastrointestinal bleeding in both genders of the older age group as a result of is a primary health concern.²⁴⁻²⁶ Another study emphasized isolated the root of anemia in older males as nutritional deficiency related to decreased iron intake, whereas the secondary concern is the bleeding from gastrointestinal system. However, in females, gynecological and gastrointestinal blood loss was found to be the primary concern with lack of iron intake because of insufficient nutrition being a secondary consideration.²⁶ Endoscopic evaluation is of great importance when detecting blood loss from the gastrointestinal system; in this manner 80-85% of the reasons for bleeding can be determined.^{25,27} Moreover, malignancy, inflammation, and use of non-steroid anti-inflammatory medicines in the older age range is common and may lead to gastrointestinal bleeding.²⁸

Evaluation of erythrocyte morphologies is very important in diagnosing anemia older people.²⁸ The rate of normocytic anemia in those aged 60 and over was seen as higher than other age groups. Çoban and colleagues determined 44.1% of anemia cases in those aged 65 and over was normocytic.¹⁷ These

results supports the idea that chronic anemia should also be considered alongside anemia caused by iron deficiency in the older anemic people.^{29,30,31} Chronic anemia, seen in the older group, can generally be classified as normocytic anemia. Chronic anemia can be seen in people with chronic infection, inflammation, and neoplastic diseases 1-2 months after the disease have begun. Nearly half of chronic anemia cases can be explained by these reasons; other reasons for anemia may be active bleeding, hemolysis, and hematological malignancies.²⁸ Chronic anemia has been identified as the third most prevalent form of anemia, after iron deficiency and thalassemia. However, anemia is generally mistakenly to arise solely from iron deficiency and patients are most often given iron supplements.²⁸

Microcytic anemia was found in more than half of anemics studied (51.2%), whereas, this condition was found in Çoban et al. at 44.9% of anemics, and in Kişioğlu et al. at 18.8%.^{4,17} The rate of the people with microcytic anemia is quite high is due to the 18-49 age group females. When people with microcytic anemia were analyzed according to gender and age groups the anemia prevalence was higher in the female 30-39 age group and 72.9% of anemic females were found to be in the 18-49 age group. The most significant reason of microcytic anemia in this age group of females is iron deficiency and blood loss from menstruation.^{28,31,32}

The prevalence of the thalassemia trait was found in 16 cities located in Mediterranean and Aegean zones at 4.3%. Although there is no data on the thalassemia trait in Tokat province, thalassemia should be considered in the evaluation of all microcytic anemia cases.³³ Macrocytic anemia was seen in 3 males out of 4 (75%) of whom were in the age group 60 and more (Table 6). Lack of B₁₂ vitamin and folat deficiency and other hematological factors, like myelodysplastic syndroms, in those in the older age range who have macrocytic anemia, should also be considered.^{29,32,34}

Hematological values in Tokat proved to be lower than the available research data obtained from the other parts of Turkey. This difference, probably due to the altitude of the Tokat region, as it is lower than the cities to which Tokat is compared. Moreover, males were shown to have higher hematological values than females due to physiological differences.

It is also important to note that prevalence of anemia in this study was much lower than WHO anemia values for Turkey. This difference may be related to nutritional habits of the people studied and their lifestyle.

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RERERENCES

1. Benoist B, McLean E, Egli I, Cogswell M. Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia. WHO Geneva: 1-2, 2008.
2. World Health Organization. Nutritional Anaemias: Report of a WHO Scientific Group. WHO Technical Reports Series 405. Geneva, Switzerland: World Health Organization, 1968.
3. Dilek İ, Erkoç R, Sayarlıoğlu M, ve ark. Van ili merkez ve kırsal kesimde yaşayan sağlıklı erişkin bireylerde hemogram ve ferritin düzeyleri. Van Tıp Dergisi 9: 52-55, 2002.
4. Kişioğlu AN, Uskun E, Kırbıyık S, ve ark. Bir dağlık bölge sakinlerinde anemi çalışması: Kekik işçileri. STED 13: 253-255, 2004.
5. The prevalence of anemia in women: A tabulation of available information. 2nd edition, WHO, Geneva, 1992.
6. Royston E. The prevalence of nutritional anemia in women in developing countries; critical review of available information. World Health Statistics 94-115, 1982.
7. Yılmaz FZ, Erdal S, Bakıcı Z, Çınar Z. Sivas ili merkezinde yaşayan erişkinlerde bazı hematolojik parametrelerin normal değerlerinin araştırılması. Erciyes Tıp Dergisi 25: 1-10, 2003.
8. Kaya H, Kiki İ, Akarsu E, ve ark. Hematological values of healthy adult population living at moderate altitude (1869 m, Erzurum, Turkey). Turk J Haematol 17:123-128, 2000.
9. Arumanayagam M, Lam YM, Swaminathan R, et al. Blood cell values in healthy Hong Kong Chinese adults. Clin Lab Haematol 9: 263-269, 1987.
10. Terzioğlu M, Savcı D, Özek A, ve ark. Türklerde normal hematolojik değerler. İstanbul Üniversitesi Tıp Fakültesi Dergisi 16:193-207, 1953.
11. Başak M, Gül S, Küçükardalı Y, ve ark. Türkiye'de hemogram değerleri ile ilgili randomize referans değer çalışması. UHOD 8: 69-72, 1998.

12. Knaupp W, Khilnani S, Sherwood J, et al. Erythropoietin response to acute normobaric hypoxia in humans. *J Appl Physiol* 73: 837-840, 1992.
13. Akdağ R, Energin M, Kalaycı G, Karakelleoglu C. Reference limits for routine haematological measurements in 7-14-year-old children living at an moderate altitude (1869 m, Erzurum Turkey). *Scand J Clin Lab Invest* 56: 103-109, 1996.
14. Dallman PR, Yip R, Johnson C. Prevalence and causes of anemia in the United States, 1976 to 1980. *Am J Clin Nutr* 39: 437-445, 1984.
15. Aktekin M, Erengin KH. 15-49 yaş grubu kadınlarda demir eksikliği anemisi. Akdeniz Üniversitesi Tıp Fakültesi, Halk Sağlığı Anabilim Dalı Araştırma Özetleri, Cilt 1, Antalya, Akdeniz Üniversitesi Yayınları 1994: 56.
16. Çoban E, Akın M, Aykut A, Timurağaoğlu A. Yaşlı hastalarda anemi sıklığı ve morfolojik olarak dağılımı. *Türk Geriatri Dergisi* 7: 131-132, 2004.
17. Coban E, Timuragaoglu A, Meric M. Iron deficiency anemia in the elderly: prevalence and endoscopic evaluation of the gastrointestinal tract in outpatients. *Acta Haematol* 110: 25-28, 2003.
18. Chernetsky A, Sofer O, Rafael C, Ben-Israel J. Prevalence and etiology of anemia in an institutionalized geriatric population. *Harefuah* 2002; 141: 591-594.
19. Joosten E, Pelemans W, Hiele M, et al. Prevalence and causes of anaemia in a geriatric hospitalized population. *Gerontology* 38:111-117, 1992.
20. Salive ME, Cornoni-Huntley J, Guralnik JM, et al. Anemia and hemoglobin levels in older persons: relationship with age, gender, and health status. *J Am Geriatr Soc* 40: 489-496, 1992.
21. Timiras ML, Brownstein H. Prevalence of anemia and correlation of hemoglobin with age in a geriatric screening clinic population. *J Am Geriatr Soc* 35: 639-643, 1987.
22. Ania BJ, Suman VJ, Fairbanks VF, et al. Incidence of anemia in older people: an epidemiologic study in a well-defined population. *J Am Geriatr Soc* 45: 825-831, 1997.
23. Toksöz P, Ceylan A, Saka G, ve ark. Diyarbakır bölgesinde okul çağı çocuklarda hematokrit ölçümü ile anemi sıklığının belirlenmesi. *Dicle Tıp Dergisi* 27: 129-137, 2000.
24. Dilek İ, Altun S, Tuncer İ, ve ark. Demir eksikliği anemisinde hemoglobin, hematokrit değerleri, eritrosit indeksleri ve etyolojik nedenlerin değerlendirilmesi. *Van Tıp Dergisi* 7: 51-56, 2000.
25. Coban E, Timuragaoglu A. Yaşlı hastalarda demir eksikliği anemisine yaklaşım. *T Klin J Med Sci* 24: 267-270, 2004.
26. Öztürk A, Özkan Y, Sezer M, ve ark. Demir eksikliği anemisi; Üç yıllık sonuçlarımız. *GATA Bülteni* 39: 204-207, 1997.
27. Gordon SR, Smith RE, Power GC. The role of endoscopy in the evaluation of iron deficiency anemia in patients over the age of 50. *Am J Gastroenterol* 89: 1963-1967, 1994.
28. Altıntaş A. Demir eksikliği anemisi ve kronik hastalık anemisinin ayırıcı tanısında eritrosit indeksleri, eritrosit dağılım genişliği ve serum ferritin düzeylerinin değeri. *Dicle Tıp Dergisi* 34: 88-93, 2007.
29. Gök DE, Doğru T, Turhan V, Kocabalkan F. Yaşlılarda kronik hastalık anemisinin tanısı ve tedavisi. *Geriatrici* 3: 163-168, 2000.
30. Türk T, Keskin A, Kaptanoğlu B. Kronik hastalık anemisi ile birlikte olan demir eksikliği anemisinin tanısında, eritrosit ferritininin önemi. *T Klin Tıp Bilimleri* 20: 226-231, 2000.
31. Haznedaroğlu İC. Erişkinlerde Demir Eksikliği Anemisi. *Hacettepe Tıp Dergisi* 29: 79, 1998.
32. World Health Organization. Diet nutrition and the prevention of chronic diseases. WHO Technical Report Series. Geneva 1990, 7-9.
33. Canatan D, Kose MR, Ustundag M, ve ark. Hemoglobinopathy control program in Turkey. *Community Genet* 9: 124-126, 2006.
34. Balducci L, Ershler WB, Krantz S. Anemia in the elderly - Clinical findings and impact on health. *Crit Rev Oncol Hematol* 58: 156-65, 2006.

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