Prevalence of anemia and associated factors among the elderly population in South Khorasan, Birjand, 2019

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Abstract

Background: Anemia is a multifactorial and common public health problem in geriatric age groups, especially in developing countries. Therefore, this study was designed to study the prevalence of anemia and associated factors among the elderly population in Birjand, Iran, in 2019.

Methods: This was a cross-sectional approach to the baseline data of the Birjand longitudinal aging study (BLAS) in which 1396 people aged ≥ 60 years were screened for the presence of anemia based on the World Health Organization (WHO) criteria. For each participant, a standard questionnaire was administered. Furthermore, the height, weight, and body mass index (BMI) were calculated. Blood samples were obtained from each participant for hematological examination. Hemoglobin, hematocrit, and other indices of cell blood count were measured using an automatic cell counter. The prevalence rates were estimated using survey analysis with the weight of Birjand county older population. Univariate and multivariable logistic regression analyses were applied to detect the associated factor with anemia.

Results: The mean age of the participants was 69.73±7.66 years. The crude prevalence of anemia was 11.10%, and the age-standardized prevalence based on the standard WHO population 2000-2025 was equal to 16.78% (12.81%–21.66%) (15.95% [10.41%–23.69%] in women and 17.32% (12.65%–23.25%) in men. Mild and normocytic anemia were the predominant types. The mean hemoglobin, hematocrit, mean cell volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were lower in women than in men and the mean platelet count in women was higher (p<0.001). In the final multivariate logistic regression model, only age groups, BMI, fish consumption, and chronic kidney disease (CKD) were related to anemia.

Conclusion: In conclusion, our findings showed the association of anemia with some risk factors and diseases. Anemia in geriatric age groups is often underdiagnosed; hence, identification of subgroups at risk for anemia and its associated risk factors in geriatric groups has a paramount importance in preventing adverse outcomes.

Keywords: Anemia, The Elderly, Population, Prevalence, South Khorasan

Introduction

According to the World Health Organization (WHO)

criteria, the elderly is defined as those with the chronolog-

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ical age of 65 years in most developed countries and 60 years for developing countries (1). The growth of the elderly population all over the world is inevitable. It is estimated that the world population from 1950 to 2050 will increase to 3.7 times, while the number of those aged 60 and above will increase by a factor approximately of 10; also, the number of the oldest persons aged 80 and above will increase by a factor of 26 (2).

Anemia is a multifactorial condition and a common public health problem in older adults, particularly in developing countries with a high prevalence in Africa and Southeast Asia. According to the WHO criteria, a hemoglobin value <12g/dL in women and <13 g/dL in men is defined as anemia in the elderly (3). Blood hemoglobin concentration decreases with aging; thus, the prevalence and incidence of anemia increase with aging (4). However, large studies from Europe and the United States have reported a global prevalence of ~17% in the cohort study and an overall prevalence of 10% to 24% in prospective registry studies in persons older than 65 years (5, 6).

Anemia in older adults is often underdiagnosed and the patient is not informed about it because it is considered as an inevitable consequence of aging (7). It is, therefore, associated with inappropriate prognosis, morbidity, and mortality.

There are several risk factors for anemia, including ethnicity, gender, age, nutritional status, poor physical and mental health, gynecological/obstetric disorders history, poor dietary habits, environment, and genetic susceptibility. Body mass index (BMI) is a simple ratio of weight to height and is used for the assessment of nutrition and health status (8).

The most common causes of anemia in the elderly population can be classified as anemia due to chronic infectious disease and chronic inflammatory diseases, such as chronic kidney disease (CKD), collagen disease, and malignancies. Another cause of anemia is nutritional deficiency anemia, such as folate, B12, and iron deficiencies, and the last one includes unexplained anemia (9).

Iron deficiency alone or in combination with other nutrients is more common among nutritional deficiencies and determining its cause is important because blood loss can be due to possible underlying malignancy or ulcer in the gastrointestinal tract and/or arteriovenous malformations (10).

It is noteworthy that 30% to 50% of the elderly with anemia have multiple causes of anemia due to being affected by several different pathological conditions and consuming a long list of medications; therefore, the etiology of anemia cannot be determined precisely, and it falls into unexplained anemia (11).

While there are numerous studies conducted on anemia in other age groups, especially children and pregnant women, not many studies have been conducted about anemia in the elderly. This study is the first large work to document the prevalence of anemia in Birjand elderly population. Therefore, this study was designed to study the prevalence of anemia and associated factors among older population residing in Birjand in 2019.

Methods

This is a cross-sectional approach to the baseline data of the Birjand longitudinal aging study (BLAS). This is an ongoing cohort study in which baseline data were collected from October 2018 to April 2019. This study used a multistage stratified cluster sampling, and the participants were representative of the population aged ≥60 years in Birjand. A comprehensive explanation about sampling and method of data collection has been mentioned elsewhere (12). Inclusion criteria were aged 60 years and over and living in Birjand. The elderly with known hematologic or cancer chemotherapy or radiation therapy, bleeding peptic ulcers, and bleeding colonic carcinoma blood transfusion during the last 6 months were excluded.

Demographic data and past medical history, including history of diabetes, hypertension, CKD and hemodialysis, history of malignancies, connective tissue diseases, liver diseases, and cirrhosis were collected by a trained researcher using an expert-approved questionnaire. Their average food intake was recorded through an interview. An anthropometric measurement, which includes height and weight measurement of people with light clothing and without shoes was conducted according to the National Health and Nutrition Examination Survey (NHENS III) protocol by a trained researcher using a Seca scale (MOD.220 model). Height was measured using a calibrated stadiometer while the participants were standing in a standard position without shoes and any head cap. Hence, BMI was computed using the following standard equation: BMI = weight (kg) / height (m^2) and participants were classified into 4 categories according to the WHO cutoff values, including underweight: BMI<18.5 kg/m^2; normal: BMI 18.5 to 24.99 kg/m^2; overweight: BMI 25-29.99 kg/m^2 and obese: BMI ≥30 kg/m^2.

Laboratory Measurement

Overnight-fasted blood samples were collected from the participants. Three milliliters of venous blood was used for hematologic indexes measurement, including cell blood count (CBC), hemoglobin (g/dL), hematocrit (%), mean corpuscular volume (MCV)(fl), mean corpuscular hemoglobin (MCH)(pg), and mean corpuscular hemoglobin concentration (MCHC) (%). The measurements were done using an automatic cell counter, SysmexKX-21 (Sysmex Corporation Kobe) automated hematology analyzer. Anemia was defined based on blood hemoglobin levels using the WHO criteria (hemoglobin < 12 g/dL for females and hemoglobin < 13g/dL for males) (4). The parametric data were presented with mean and standard deviation. The severity of anemia was graded based on the hemoglobin levels, where <7 g/dL was considered as severe anemia, hemoglobin levels 7 g/dL ≤ hemoglobin <10 g/dL as moderate anemia, and hemoglobin levels ≥10 and <12 in women and ≥10 and <13 in men as mild anemia (18). Anemia was classified based on MCV. The MCV <70fl was defined as microcytic, 70fl ≥ MCV <100fl normocytic and those with MCV ≥100fl as macrocytic anemia (13).

Ethical Consideration

This study was approved by the ethical research board of Birjand University of Medical Sciences (Ethical Code = IR.bums.REC.1398.135). All the participants signed an informed consent after being completely informed about the aim and process of the research project.

Statistical Analysis

The data were analyzed by the Stata software (Version 12, Stata Corp). To compare demographic characteristics and food intake in participants with and without anemia, a t test, a chi-square, and a Fisher test were used. A survey analysis with weighing for age groups of Birjand county was performed to determine the prevalence of anemia. Age standardization according to WHO population was also performed for reporting of the prevalence of anemia.

The association between anemia and other factors were evaluated using logistic regression models. The final model was constructed by the backward multivariable logistic regression method and all of the variables that had a P value of association higher than.10 (except sex) were omitted from the model. P values <0.05 were considered as statistically significant.

Results

The data of 1396 people aged ≥60 years who were enrolled in the BLAS, with completed data about cell blood counting, were considered for analyses. The mean age of the participants was 69.73 (SD, 7.66) years, and 51.4% (n=718) of the participants were women. The crude prevalence of anemia in this study was 11.10 % (n=155). The BMI was lower in those with anemia than those without

Table 1. General Characteristics and Nutritional Intake of the Participants With and Without Anemia

Variable		Total Population N = 1396		Participant Without Anemia N = 1241		Participants With Anemia N = 155		p
		Mean or Number	SD or %	Mean or Number	SD or %	Mean or Number	SD or %	
Age (year) (mean, SD)		69.73	7.66	69.33	7.52	72.88	8.02	<0.001
Gender (female) (N, %)		718	51.43	648	52.22	70	45.16	
Education level (N, %)	Illiterate	628	45.05	552	44.55	76	49.03	
	Primary	438	31.42	391	31.56	47	30.32	
	High school	77	5.52	66	5.33	11	7.10	0.490
	Diploma	137	9.83	126	10.17	11	7.10	
	Academic	114	8.18	104	8.39	10	6.45	
Marital status (N, %)	Married	1,141	81.73	1,015	81.79	126	81.29	
	Single	6	0.43	5	0.40	1	0.65	0.463*
	Widow	234	16.76	206	16.60	28	18.06	
	Separated	15	1.07	15	1.21	0	0	
Jobs status (N, %)	Retired	522	37.42	464	37.42	58	37.42	
	Employed	176	12.62	154	12.42	22	14.19	0.922
	House keeper	628	45.02	561	45.24	67	43.23	
	Unemployed	69	4.95	61	4.95	8	5.16	
BMI (Kg/m2)(mean, SD)		26.39	5.13	26.52	4.86	25.36	6.68	0.008
WC (cm) (mean, SD)		95.23	11.83	95.66	11.60	91.8	13.08	<0.001
BMI categorized WHO (N, %)	Underweight (BMI <18.5)	66	4.73	51	4.11	15	9.68	
	Ideal body weight (18.5 ≤ BMI <25)	501	35.91	426	34.35	75	48.39	<0.001
	Overweight (25 ≤BMI <30)	536	38.42	499	40.24	37	23.87	
	Obese (BMI ≥30)	292	20.3	264	21.29	28	18.06	
Meat consumption	No use	193	13.84	171	13.79	22	14.19	0.677
	1-3 times/Wk	1,127	80.79	1000	80.65	127	81.94	0.677
	>4 times / Wk	75	5.38	69	5.56	6	3.87	0.677
Poultry consumption	No use	108	7.74	98	7.90	10	6.45	0.707
	1-3 times/Wk	1,186	85.02	1,054	132	132	85.16	0.707
	>4 times / Wk	101	7.24	88	7.10	13	8.39	0.707
Fish consumption (Yes)		314	22.51	270	21.77	44	28.39	0.063
Milk consumption	No use	467	33.48	421	33.95	46	29.68	0.017
	1-3 times/Wk	370	26.52	339	27.34	31	20.00	0.017
	>4 times / Wk	558	40.00	480	38.71	78	50.32	0.017
Cheese consumption	No use	168	12.04	147	11.85	21	13.55	0.743
	1-3 times/Wk	211	15.13	186	15.00	25	16.13	0.743
	>4 times / Wk	1,016	72.83	907	73.15	109	70.32	0.743
Fruits consumption	Zero or once/Wk	96	6.88	83	6.69	13	8.39	0.723
	2-4 times/Wk	980	70.25	872	70.32	108	69.68	0.723
	>4 times / Wk	319	22.87	285	22.98	34	21.94	0.723
Vegetable eating	No use	307	22.02	261	21.07	46	29.68	0.044
	1-3 times/Wk	626	44.91	566	45.68	60	38.71	0.044
	>4 times / Wk	461	33.07	412	33.25	49	31.61	0.044
Digestive problems (Yes)		297	21.31	260	20.98	37	23.87	0.470
Hemorrhoid (Yes)		72	5.16	62	5.00	10	6.45	0.731
Cancer (Yes)		1,359	99.12	1,211	99.02	148	100.00	0.226

*Fisher exact test; SD: standard deviation; BMI: body mass index; Wk: week.

anemia (25.36 vs 26.52; p=0.008). The frequency of self-reported CKD was higher in participants with anemia than those who did not have anemia (Table 1). The intake of different types of food was assessed as well. In participants with anemia, the rate of using milk per week was higher than those without anemia (p=0.017), and the rate of using vegetables was lower in those with anemia than those without anemia (Table 1).

The mean of hemoglobin, hematocrit, red blood cell count (RBC), MCV, MCH, and MCHC was lower in women than in men (p<0.001). However, the mean platelet count in women was higher than in men (240 × 10³/ m³ in women than 206×10³ m³ in men) (Table 2).

The prevalence of anemia was more common in older men (12.54%; n=85) than older women (9.75%; n=70). After considering the weight and performing a standardization for the WHO population, the prevalence of anemia in the studied population was calculated as 16.78%, (95% CI, 12.82%-21.66%). The WHO age-standardized prevalence of anemia in women was estimated as 15.96% (95% CI, 10.41%-23.69%) and 17.32% (95% CI, 12.65%-23.25%) in men. Overall, the age-standardized prevalence of anemia was higher in older age groups who had a low body weight than those who were in younger groups and had higher BMI groups (Table 3). More than 90% of the participants with anemia were classified as having a mild anemia according to the WHO definition of anemia and less than 1% of the studied population were classified as having severe anemia. Moreover, the participants were assessed in terms of MCV and were categorized into groups with microcytic, normocytic, and macrocytic RBC. Only 1.9% of the participants with anemia and 0.75% of those who had no anemia had microcytosis (Fig. 1).

In univariable logistic regression models, the associa-

Table 2. Hematological Indices in Participants and Both Genders

Hematologic indices	Total N =1396		Female N = 718		Male N = 678		p
	Mean	95% CI mean	Mean	95% CI mean	Mean	95% CI mean	
Hemoglobin (g/dl)	14.22	14.13 - 14.31	13.57	13.47 - 13.67	14.91	14.79 - 15.03	< 0.001
HCT (%)	41.68	41.46 - 41.91	40.17	39.90 - 40.43	43.30	42.98 - 43.61	< 0.001
RBC × 10⁶/mm³	4.76	4.71 - 4.82	4.65	4.57 - 4.73	4.90	4.83 - 4.97	< 0.001
WBC × 10³/mm³	6.27	6.19 - 6.36	6.20	6.08 - 6.31	6.36	6.23 - 6.49	0.045
MCV (fl)	85.89	85.60 - 86.17	85.26	84.87 - 85.64	86.56	86.15 - 86.97	< 0.001
MCH (pg)	29.34	29.19 - 29.50	28.91	28.65 - 29.16	29.81	29.64 - 29.98	< 0.001
MCHC (%)	34.10	34.02 - 34.19	33.78	33.67 - 33.89	34.44	34.32 - 34.56	< 0.001
Platelet× 10³/mm³	228.61	224.98 - 232.25	245.10	240.00 - 250.21	211.01	206.20 - 215.82	< 0.001

CI: confidence interval, HCT: hematocrit, RBC: Red blood cell count, WBC: White blood cell count, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration.

Table 3. Age Standardized Prevalence of Anemia Based on WHO Population

Prevalence of anemia		Total population N=1396		Female N= 718		Male N= 678	
		Point estimation	95% CI Point estimation	Point estimation	95% CI Point estimation	Point estimation	95% CI Point estimation
Total prevalence of Anemia		16.78	12.81 – 21.66	15.96	10.41 – 21.69	17.32	12.65 – 23.25
Prevalence of anemia based on BMI groups (%)	LBW	23.14	14.11 - 35.55	8.67	1.25 – 41.66	30.30	18.50 – 45.44
	IBW	14.34	11.50 – 17.72	13.94	9.69 – 19.65	14.60	11.05 – 19.05
	Overweight	6.44	4.63 – 8.89	7.43	4.80 – 11.34	16.28	7.08 – 33.18
	Obese	9.73	6.69 – 13.92	10.36	6.68 – 15.73	5.34	3.25 – 8.67
Prevalence of anemia based on age groups (%)	60-64 years	6.57	4.57 – 9.36	7.76	4.94 - 11.98	8.07	3.99 – 15.65
	65-69 years	8.58	603 - 1206	7.10	4.33 – 11.46	10.07	6.16 - 16.04
	70-74 years	13.64	10.00 – 18.32	10.43	6.02 – 17.49	16.89	11.67 - 23.82
	75-79 years	17.29	12.28 – 23.79	16.09	9.76 – 25.37	18.52	11.48 - 28.49
	80-84 years	14.54	9.16 – 22.32	11.36	4.80 – 24.56	17.39	10.14 - 28.19
	85+ years	22.53	13.35 – 35.43	24.00	11.19 – 44.18	20.51	10.60 - 35.98

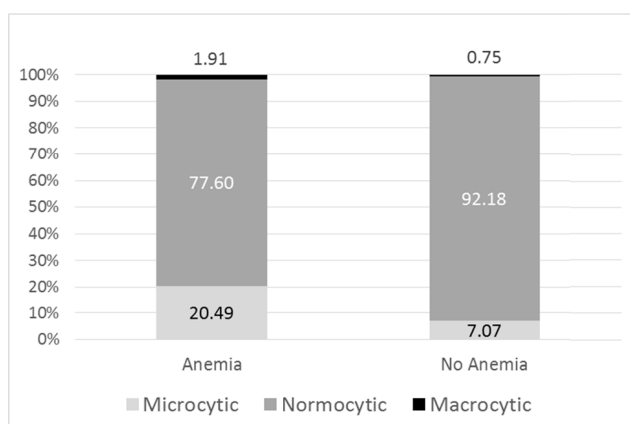CI: confidence interval; LBW: low body weight; IBW: Ideal body weight; BMI: body mass index.

Fig. 1. Frequency of microcytosis, normocytic, and macrocytosis in the participants based on MCV with and without anemia (age-standardized based on WHO population).

tion between anemia and demographic, anthropometric dietary, and self-reported history of disorders was assessed. The odds ratios for anemia in those aged 85 years old were 3.95% higher than those aged 60-64 years and older. Furthermore, the odds ratio of anemia in overweight and obese participants was 75% and 65% less than those who were underweight, respectively (OR of anemia, 0.25; CI 95%, 0.13-0.40 in overweight individuals and odds ratio equal to 0.35; CI 95%, 0.17-0.70 for obese participants). Participants who drank milk 4 times or more per week had odds equal to 1.49 of anemia compared to those who did not drink milk at all. Those who consumed vegetables had 40% lower odds of anemia than those who did not consume vegetables at all. Only self-reported CKD was associated with anemia (OR, 3.38) in univariable models and other diseases were not related (Table 4). We used the backward method for assessing the factors that were related to anemia (the cutoff of p>0.10) and sex was preserved in the model because a strong relationship between anemia and gender was reported in other studies. In the final multivariable logistic regression model, only age (OR increased with aging), BMI (ORs was significantly lower in those who were overweight and obese compared to those who had low body weight), fish consumption (the OR was 1.52 in consumers than nonconsumers), and CKD

were related to anemia (Table 4).

Discussion

The crude prevalence of anemia in this study was more than 11% and the WHO age-standardized prevalence of anemia was about 16.8%. To our knowledge, several studies in the literature have reported the prevalence of anemia in the elderly, but there are a few large-scale population-based studies with a high inclusion rate.

The prevalence of anemia in our study is similar to a prospective population-based study in 2010 on 8744 elderly aged 65 years or older in Biella (Italy) according to the WHO criteria with a prevalence rate of 11.8% (10). Also, there is a low prevalence in Mexican and Brazilian elderlies, 7.7% (14), and a high prevalence rate in Kashmir, 77.5% (15). The possible reasons for inconsistencies might be differences in the demographic composition of the participated population and most of these studies did not report the age-standardized prevalence. Also, the prevalence of anemia changes by the definitions and the differences in cutoff points for the selection of older age in developed and developing countries.

In our study, the age-standardized prevalence of anemia was about 17.3% in men and near 16% in women. This is in accordance with the study by Kaur et al (2014) who

Table 4. Associated Factor with Anemia in Univariate and Multivariable Logistic Regression Models

Variables		Univariate Models			Multivariate Models		
		Odds Ratio	95% CI Odds Ratio	p	Odds Ratio	95% CI Odds Ratio	p
Gender (male/female)		1.33	0.95 - 1.86	0.098	1.13	0.77 - 1.67	0.534
Age group	60 -64 years			Reference group			
	65-69 years	1.28	0.75 - 2.19	0.362	1.13	0.65 - 1.96	0.658
	70-74 years	2.31	1.38 - 3.87	0.002	1.87	1.10 - 3.19	0.021
	75-79 years	2.94	1.69 - 5.12	0.000	2.51	1.42 - 4.43	0.002
	80-84 years	2.50	1.31 - 4.75	0.005	1.66	0.84 - 3.28	0.141
	85+ years	3.95	1.95 - 8.00	0.000	2.65	1.26 - 5.57	0.010
BMI	Low body weight			Reference group			
	Ideal body weight	0.60	0.32 - 1.12	0.108	0.60	0.34 - 1.25	0.196
	Overweight	0.25	0.13 - 0.49	0.001	0.30	0.15 - 0.60	0.001
	Obese	0.35	0.17 - 0.70	0.003	0.46	0.22- 0.98	0.044
Meat	No Use			Reference group			
	1-3 times per week	0.99	0.61 - 1.60	0.958			
	4+ times per week	0.68	0.26 - 1.74	0.417			
Chicken	No use			Reference group			
	1-3 times per week	1.23	0.62 - 2.41	0.552			
	4+ times per week	1.45	0.60 - 3.47	0.406			
Fish consumption (User/Non-user)		1.42	0.98 - 2.07	0.064	1.52	1.02 - 2.27	0.040
Milk consumption	No use			Reference group			
	1-3 times per week	0.84	0.52 - 1.35	0.465	0.87	0.53- 1.43	0.582
	4+ times per week	1.49	1.01 - 2.19	0.044	1.46	0.96- 2.20	0.074
Cheese consumption	No use			Reference group			
	1-3 times per week	0.94	0.51 - 1.75	0.847			
	4+ times per week	0.84	0.51 - 1.38	0.497			
Egg consumption	No use			Reference group			
	1-3 times per week	1.00	0.59 - 1.70	0.993			
	4+ times per week	0.74	0.38 - 1.45	0.382			
Fruit consumption	Use ≤ one serve /day			Reference group			
	2-4 serves /day	0.79	0.43 - 1.47	0.456			
	4 serves or more	0.76	0.38 - 1.51	0.436			
Vegetables consumption	No use			Reference group			
	1-3 times per week	0.60	0.40 - 0.90	0.015	0.68	0.42 - 1.05	0.085
	more than 3 times	0.67	0.44 - 1.04	0.074	0.77	0.49 - 1.31	0.277
Hemorrhoid (Yes/No)		1.31	0.66 - 2.61	0.444			
GI Problem (Yes/No)		1.18	0.80 - 1.75	0.408			
CKD (Yes/No)		3.38	1.69 - 6.76	0.001	3.60	1.75 - 7.42	0.001

CI: Confidence interval, BMI: Body mass index, GI: Gastrointestinal, CKD: Chronic kidney disease

studied 2540 people aged 60 years and older. Their results showed that there was more anemia in men than in women (58% vs 42%) (16).

In contrast, Obaidely et al found that anemia is more prevalent in elderly women than in elderly men (40.6% vs 28.7%) who lived in nursing homes in Qatar (17).

A sex difference in hemoglobin levels was found in both animals and humans, which might be related to the effect of sex hormones (estrogen and testosterone) on erythropoiesis. However, erythropoietin levels in men and premenopausal and postmenopausal women are the same. Therefore, the hormone effect must take place possibly in another location like kidney rather than bone marrow as documented in a previous study (18). Erythropoietin is a glycoprotein growth factor mainly produced by kidneys in a hypoxic condition. Since estrogen and testosterone have vasodilation and vasoconstriction effects in renal vasculature, respectively, they may cause different hematocrit in arterioles, capillaries, and venules as well as different oxygen delivery rates per red blood cell (18). We found a higher prevalence of anemia in older men than in older women, while the mean hemoglobin level in men was higher than in women. In other words, we have a discrepancy between hemoglobin level and anemia that is justified by a different definition of anemia in different genders.

Our results showed that the prevalence of anemia increased with aging in both genders.

Our results support those of the study of Orces conducted on older adults residing in the Coastal and Andes mountains in Ecuador (13). Like most organs and tissues, hematopoietic aging is evident as a reduced adaptive immune system, which induces immune dysfunction and increased incidence of myeloproliferative diseases, including myelodysplastic syndromes (MDS) and increased anemia (19). A cellular and molecular damage for hematopoietic stem cells (HSC) with aging has been shown as both cell-intrinsic and cell-extrinsic mechanisms (19). Cell-extrinsic mechanisms are the alterations in bone marrow niche composition, including an increase in adipose tissue and a decrease in overall hematopoietic tissue. Cell-intrinsic mechanisms include alterations in transcriptional profiles and changes in the global epigenetic profile. Furthermore, the humoral control of erythropoiesis changes with aging could take place because of either an increased erythropoietin demand in anemic older adults that do not meet the increased demand or as a decreased capacity of renal hormone production, which can lead to the development of anemia (20).

In this study, those with low body weight had a higher standardized rate of anemia than the other groups of WHO BMI categorized groups. BMI is frequently used as a measure of nutritional and health status, and low BMI in some previous studies has been identified as an independent risk factor for anemia in older adults (8). A study showed strong associations between BMI and hemoglobin level and anemia (21). However, Lee et al found that none of the anthropometric indices were good indicators of the hemoglobin level (22). A low BMI may be associated with anemia due to malnutrition and malabsorption of essential micronutrients, such as iron, vitamin B12, folate, zinc, and vitamin D, as many studies have shown that diet modification and proper nutrition are related to improvement in anemia (23, 24). It is noteworthy to mention that nutritional deficiency is also associated with some factors, including cultural beliefs and religious prohibitions and socioeconomic factors (25).

In this context, in our study, participants with anemia used more milk per week than those without anemia. Anemia in these people may be due to a decrease in gastric acid secretion, which can decrease the absorption of iron and vitamin B12 in aged people. Furthermore, lactose intolerance is common in elderly individuals and is accompanied by abdominal distention, flatulence, diarrhea, and pain after ingestion of dairy products (26).

Self-reported chronic kidney disease was associated with 3.4 higher risk of anemia. Our results are in agreement with Orcs on older adults residing in the Coastal and Andes mountains in Ecuador (13). However, our results are in contrast with Nalado et al who tested 353 CKD adult patients in Charlotte Maxeke Johannesburg Academic hospital (27). Low hemoglobin levels in the elderly with CKD or renal anemia is a common problem. The humoral control mechanism of erythropoiesis is mainly associated with erythropoietin; hence, erythropoietin deficiency is accepted as a leading cause of renal anemia. Accordingly, the kidney is considered as the main source of erythropoietin in response to a hypoxic condition (28). Different studies have shown conflicting results about erythropoietin levels in elderly participants, possibly due to comorbidities accompanying in aged people (29), including diabetes as the most common cause of CKD. Other possible causes for renal anemia are the accumulation of uremic toxins that inhibits erythropoiesis and reduces red blood cell (RBC) lifespan due to the uremic environment in CKD patients.

Also, 77.6% of anemic individuals in our study were normocytic based on MCV results and this kind of anemia is associated with chronic diseases. CKD was only associated with anemia in this study among other studied diseases, including cancer and digestive diseases. Anemia due to chronic disease or inflammation is a common consequence of chronic diseases, including infections, inflammatory conditions, and malignancies (17, 30).

There are some limitations in this study. First, since this study had a cross-sectional design, it was not possible to determine the direct associations and consequently the causations. Second, it was not possible to measure the markers related to the causes of anemia, including interleukin (IL-6), ferritin, folate, and vitamin B12.

Conclusion

In conclusion, the prevalence of anemia among the studied geriatric groups was found to be an important public health problem with the most common type of normocytic. Our findings showed the association of anemia with some risk factors and diseases, such as gender, age, BMI, and CKD. Thus, an appropriate clinical approach is essential to treat anemia in the elderly because anemia often remains underreported and is inadequately investigated,

particularly the mild form.

Conflict of Interests

The authors declare that they have no competing interests.

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