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Prevalence of anemia and associated factors in older adults: evidence from the SABE Study

Prevalência de anemia e fatores associados em idosos: evidências do Estudo SABE

ABSTRACT

OBJECTIVE: To assess the prevalence of anemia and associated factors in older adults.

METHODS: The prevalence and factors associated with anemia in older adults were studied on the basis of the results of the *Saúde, Bem-Estar e Envelhecimento* (SABE – Health, Welfare and Aging) study. A group of 1,256 individuals were interviewed during the third wave of the SABE study performed in Sao Paulo, SP, in 2010. The study included 60.4% females; the mean age of the participants was 70.4 years, and their average education was 5.3 years. The dependent variable was the presence of anemia (hemoglobin levels: 12 g/dL in women and 13 g/dL in men). Descriptive analysis and hierarchical logistic regression were performed. The independent variables were as follows: a) demographics: gender, age, and education and b) clinical characteristics: self-reported chronic diseases, presence of cognitive decline and depression symptoms, and body mass index.

RESULTS: The prevalence of anemia was 7.7% and was found to be higher in oldest adults. There was no difference between genders, although the hemoglobin distribution curve in women showed a displacement toward lower values in comparison with the distribution curve in men. Advanced age (OR = 1.07; 95%CI 0.57;1.64; $p < 0.001$), presence of diabetes (OR = 2.30; 95%CI 1.33;4.00; $p = 0.003$), cancer (OR = 2.72; 95%CI 1.2;6.11; $p = 0.016$), and presence of depression symptoms (OR = 1.75; 95%CI 1.06;2.88; $p = 0.028$) remained significant even after multiple analyses.

CONCLUSIONS: The prevalence of anemia in older adults was 7.7% and was mainly associated with advanced age and presence of chronic diseases. Thus, anemia can be an important marker in the investigation of health in older adults because it can be easily diagnosed and markedly affects the quality of life of older adults.

DESCRIPTORS: Aged. Anemia, epidemiology. Risk Factors. Health Surveys. SABE Study.

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RESUMO

OBJETIVO: Analisar a prevalência de anemia e os fatores associados em idosos.

MÉTODOS: Com base no Estudo SABE (Saúde, Bem-Estar e Envelhecimento), foram estudados a prevalência e os fatores associados à anemia em idosos. Foram entrevistados 1.256 indivíduos na terceira coleta do Estudo SABE em São Paulo, SP, em 2010, sendo 60,4% do sexo feminino, média de idade de 70,4 anos e escolaridade média de 5,3 anos de estudo. A variável dependente foi presença de anemia (hemoglobina < 12 g/dL para mulheres e < 13 g/dL para homens). Realizou-se análise descritiva e regressão logística hierárquica. As variáveis independentes foram: a) bloco sociodemográfico: sexo, idade, escolaridade; e b) bloco de saúde: relato de doenças crônicas, presença de declínio cognitivo e de sintomas depressivos, índice de massa corporal.

RESULTADOS: A prevalência de anemia foi de 7,7%, tendo sido maior em idosos mais longevos. Não houve diferença entre os sexos, mas a curva de distribuição de hemoglobina das mulheres foi deslocada em direção aos valores mais baixos em relação à curva referente aos homens. Idade mais avançada (OR = 1,07; IC95% 0,57;1,64; p < 0,001), presença de diabetes (OR = 2,30; IC95% 1,33;4,00; p = 0,003), câncer (OR = 2,72; IC95% 1,21;6,11; p = 0,016) e sintomas depressivos (OR = 1,75; IC95% 1,06;2,88; p = 0,028) permaneceram significantes após análise múltipla.

CONCLUSÕES: A prevalência de anemia na população idosa de São Paulo foi de 7,7% e esteve associada principalmente à idade mais avançada e doenças crônicas. A anemia deve ser um marcador importante na investigação de saúde em idosos, por ser facilmente detectada e impactar fortemente na qualidade de vida do idoso.

DESCRITORES: Idoso. Anemia, epidemiologia. Fatores de Risco. Inquéritos Epidemiológicos. Estudo SABE.

INTRODUCTION

Anemia is defined as the pathological decrease in hemoglobin levels in the blood and is caused by several pathophysiological mechanisms.[24] It is the most common hematologic dysfunction in older adults. Begué et al (2004) reported different prevalence rates of anemia in older adults: from 2.9% to 61.0% in men and 3.3% to 41.0% in women.[4] In most cases, hemoglobin levels are reduced approximately 1 g/dL below the expected levels.[12,16]

Anemia in older adults has multiple etiologies, with one-third cases attributed to nutritional deficiencies (iron, folate, and vitamin B_{12}) and one-third to chronic diseases (particularly renal diseases) and/or inflammation. The erythropoietic response is inadequate when there are high circulating levels of pro-inflammatory cytokines such as interleukin-6 (IL-6). The underlying mechanisms in the remaining one-third cases have not been elucidated yet.[10,12]

The prevalence of anemia appears to increase with age. A study in the USA evaluated data from the Third National Health and Nutrition Examination Survey (NHANES III) and showed higher prevalence in older adults aged ≥ 85 years, particularly men. The prevalence among women was 8.5% in the age group of 65 to 74 years and 20.1% in the age group of > 85 years; in the same age groups, the prevalence among men was 7.8% and 26.1%, respectively.[10]

Data on anemia in older adults in Brazil are limited. Cross-sectional studies performed in Pernambuco, Northeastern Brazil, Minas Gerais, and Sao Paulo, Southeastern Brazil, have showed prevalence between 4.5% and 11.0%.[3,20,21]

The objective of this study was to assess the prevalence of anemia and associated factors in older adults.

METHODS

Based on the results of the *Saúde, Bem-Estar e Envelhecimento* (SABE – Health, Welfare and Aging) study, a longitudinal study initiated in 2000 with a probability sample of 2,143 older adults (≥ 60 years)

living in Sao Paulo, SP, we investigated the prevalence and factors associated with anemia in older adults. The reference sample (cohort A) was obtained by stratified two-stage sampling according to the censitary sectors of the city. Individuals aged ≥ 75 years were oversampled because of the higher mortality rate in this age group. Details regarding the sampling design of the initial study have been described in a previous publication.[11]

In 2006, the second round of interviews was performed with 1,115 individuals. A new sample (cohort B, n = 298) of older adults aged 60-64 years was obtained following the same method used in the first visit, because this age group was not represented in the first cohort.

The third follow-up visit took place between 2010 and 2011, with 748 individuals from the initial sample and 242 from the 2006 sample. A third sample of older adults aged 60-64 years was included (cohort C, n = 355).

Almost half of the individuals from the initial cohort that were not represented in the period between the beginning of the study and the third follow-up visit died within this period (44.2%). A small percentage of individuals (20.9%) were lost to follow-up because of other reasons, such as moving to another city, refusal to respond, and individuals who were not found. Sampling weights were recalculated in 2010 according to the 2010 census in order to maintain a representative sample. Weights derived from posteriori stratification were incorporated to the weights related to the sample design.

The 2010 sample included 1,345 older adults (≥ 60 years) who represented approximately 1,338,138 older adults living in Sao Paulo. The final sample that was evaluated consisted of 1,256 individuals whose biochemical test results were available on the third visit (Figure 1).

The study involved home interviews in all follow-up visits. Each interview was performed by a single interviewer using a standard questionnaire that addressed the living and health conditions of older adults. Quantification of anthropometric data and physical performance tests were also conducted by trained nutritionists.

Blood collection and tests were included on the third visit (2010/2011). Participants were instructed to fast for 10h to 12h prior to blood withdrawal. Blood collection was performed at the residence of the older adults by trained nurse technicians using venous puncture in the sitting position. Hemoglobin levels were determined using an electronic counter at the *Laboratório do Instituto do Coração da Faculdade de Medicina da Universidade de São Paulo*. Participants received a copy of the test results. Details regarding the third follow-up visit of the SABE study can be found in the study of Corona et al.[6]

Anemia was identified on the basis of blood hemoglobin levels using the World Health Organization hemoglobin cut-off points:[24] 12 g/dL for women and 13 g/dL for men.

Mean and standard deviation were calculated for continuous variables, and proportions were calculated for categorical variables. Differences between groups were estimated using the Wald test of mean equality and the Rao-Scott test; both tests consider sampling weights for the estimate of population with population weights.

Hierarchical logistic regression was performed to analyze factors associated with anemia. The conceptual model

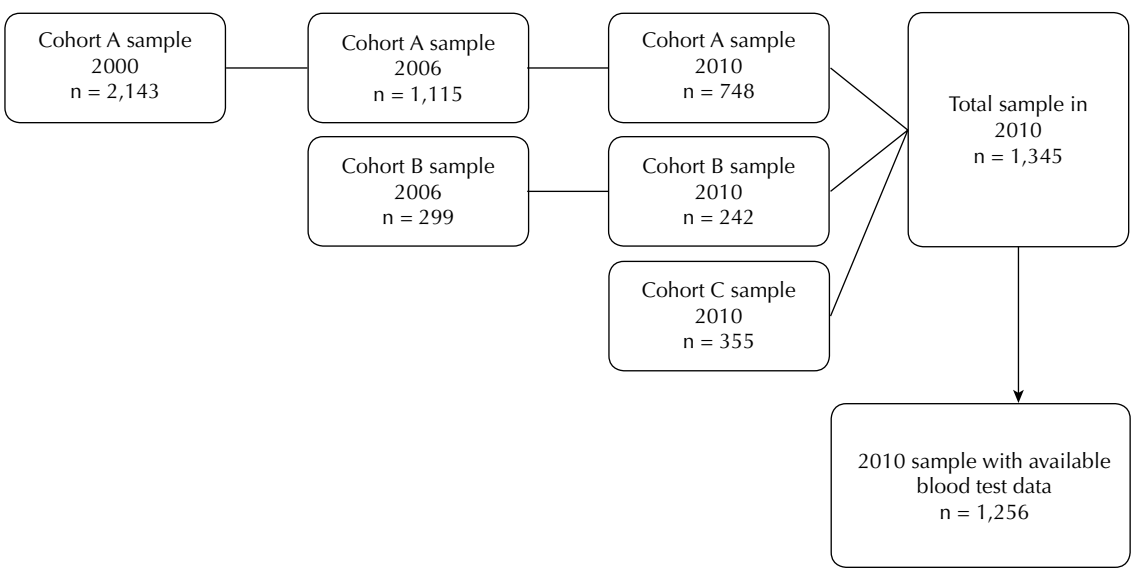

Figure 1. Composition of the study population at third follow-up visit of the SABE study. Sao Paulo, SP, Southeastern Brazil, 2010.

was based on the assumption that although demographic characteristics directly influence anemia, the occurrence of chronic conditions in older adults takes precedence. These conditions can have a stronger influence on the occurrence of anemia.[1,26] The factors investigated were divided in two groups. The group of demographic variables was included first, followed by the clinical variables group. The variables selected in the first group were kept in the model despite the fact that statistic significance could not be maintained after the inclusion of the subsequent group, and remained as adjustment factors for the proximal group. Values of $p \leq 0.2$ were selected for univariate analyses performed to select the variables intended for modeling. The groups were separated as follows:

- demographic characteristics (distal group): gender, age, and education (years of schooling);
- clinical characteristics (proximal group): presence of self-reported chronic diseases (hypertension, diabetes, cardiovascular disease, encephalic vascular accident, osteoporosis, and cancer), positive screening for depression symptoms, cognitive decline, and body mass index (kg/m^2). The occurrence of depression symptoms was evaluated considering the Brazilian version of the Geriatric Depression Scale, with a score of ≥ 6 indicating positive results.[18] Screening for cognitive decline was performed using the modified version of the *Mini Exame do Estado Mental* (MEEM – Mini-Mental State Examination) that was validated for the SABE study. This scale has 13 items (maximum score of 19 points), it is less dependent on education, and the cut-off point used for positive screening is ≤ 12.[11]

The model adjusted by the demographic variables was called "partial model", whereas the "final model" was adjusted by the two groups. It was considered that identification of a statistically significant association ($p < 0.05$) between a given variable under study and the outcome in question, after adjustment for the potential variables of the same group and of the superior hierarchical groups, would indicate existence of an independent effect, inherent to the given variable.

The variables included in this analysis were evaluated on the third visit. Data analysis was performed with Stata® version 11. The sampling weights were applied in all analyses.

This study was approved by the *Comitê de Ética em Pesquisa da Faculdade de Saúde Pública* of the *Universidade de São Paulo* (Process 2,044 of 2010). Participation was voluntary and all participants signed the informed consent form.

RESULTS

Approximately 60.4% of older adults in the study were females. The mean age of the participants was 70.4 years, and their average education was 5.3 years. Anemia was identified in 7.7% of the studied population, being present in 7.3% of men and 7.9% of women (Table 1).

The prevalence of anemia was higher in the following: 1) oldest adults; 2) those with less education; 3) those with positive screening for cognitive decline; 4) those who reported previous diagnosis of hypertension, diabetes, cancer, cardiovascular disease, encephalic vascular accident/embolus, osteoporosis, or three or more chronic diseases; and 5) those with depression symptoms. There was no significant difference related to the nutritional state.

Despite the fact that there was no difference in the prevalence of anemia between genders, the distribution of hemoglobin levels showed important differences between men and women. The distribution curve of hemoglobin levels among women was displaced to the left, toward the lower values, whereas among men, it was displaced to the right (Figure 2).

Regarding age groups, the distribution of hemoglobin levels showed similar curves among older adults aged 60-69 years and 70-79 years, whereas the distribution curve of older adults aged ≥ 80 years was displaced to the left, toward the lower values (Figure 3).

Age continued to be a significant factor after inclusion of the first group of variables in the hierarchical logistic regression model. Furthermore, age and presence of diabetes, depression symptoms, and cancer remained statistically significant after inclusion of the clinical variables in the final model (Table 2).

DISCUSSION

The prevalence of anemia in the population of older adults in Sao Paulo was 7.7%, which is slightly lower than the prevalence in developed countries such as the USA (10.6%).[10] In a systematic review by Gaskell et al[8] (2008), the average prevalence of anemia in older adults in the community was 12.0%. This study included older adults aged ≥ 65 years, which could explain the higher prevalence. Furthermore, the few Brazilian studies on anemia in older adults show different prevalence rates: 4.5% in Bambuí, MG, and 10.0%-11.0% in Sao Paulo and Camaragibe, PE.[3,20,21]

It is possible that these inconsistences are because of the differences between the populations under investigation. The low prevalence in Bambuí[21] can be attributed to the high level of involvement of the cohort population in health monitoring, which stimulated better health control and overall conditions in this population. The Camaragibe,[3] study covered a population from the Northeast of Brazil, which is known to be less educated and to have less access to health services in addition to having higher

Table 1. Distribution of older adults (%) by the presence of anemia, demographics, and clinical characteristics. SABE study, Sao Paulo, SP, Southeastern Brazil, 2010.

Variable	Older adults		p
	Non-anemic	Anemic	
Gender			0.723
Male	92.7	7.3	
Female	90.1	7.9	
Age group (years)			< 0.001
60 to 69	95.9	4.1	
70 to 79	90.6	9.4	
≥ 80	83.1	16.9	
Education (years of schooling, average)	5.4	4.1	0.002
Cognitive status			< 0.001
With decline	93.2	6.8	
Without decline	85.3	14.7	
Presence of hypertension			0.034
No	94.4	5.6	
Yes	91.3	8.7	
Presence of diabetes			< 0.001
No	94.0	6.0	
Yes	87.2	12.8	
Presence of cancer			0.015
No	93.0	7.0	
Yes	85.3	14.7	
Presence of cardiovascular disease			< 0.001
No	93.8	6.2	
Yes	87.4	12.6	
Presence of EVA/embolus			< 0.001
No	93.1	6.9	
Yes	82.3	17.7	
Presence of osteoporosis			0.028
No	92.9	7.1	
Yes	89.8	10.2	
Presence of depression symptoms			0.031
No	93.7	6.3	
Yes	90.0	10.0	
Body mass index (kg/m^2)	28.4	27.4	0.110
Total	92.3	7.7	

EVA: Encephalic Vascular Accident

exposure to food insecurity.[9,19,22] The Camaragipe population appears to have a demographic profile similar to that of the Sao Paulo population,[20] with a similar prevalence. This is because although the referred study[20] was performed in Sao Paulo, a big city with higher average years of schooling and more access to health services, the study covered neighborhoods of low demographic conditions in the Butantã region and included older adults aged ≥ 65 years. Our study, also performed in Sao Paulo with older adults, utilized a probability sample representative of the population. While providing more health services than smaller municipalities, Sao Paulo has older adults of all demographic levels and with different levels of access to the health services.

The proportion of anemic individuals did not differ between men and women. This is because menstrual blood loss ceases in older women, making the risk of anemia equal for both genders. Consistent with these findings, a study has reported that in the USA, the prevalence of anemia in adults is higher in women than in men; however, between 65 and 74 years of age, the prevalence is similar.[10] Several studies have discussed whether or not it is reasonable to use lower cut-off points for women even many years after menopause, because hemoglobin levels between 12 g/dL and 13g/dL are predictive of adverse consequences.[5,10,25]

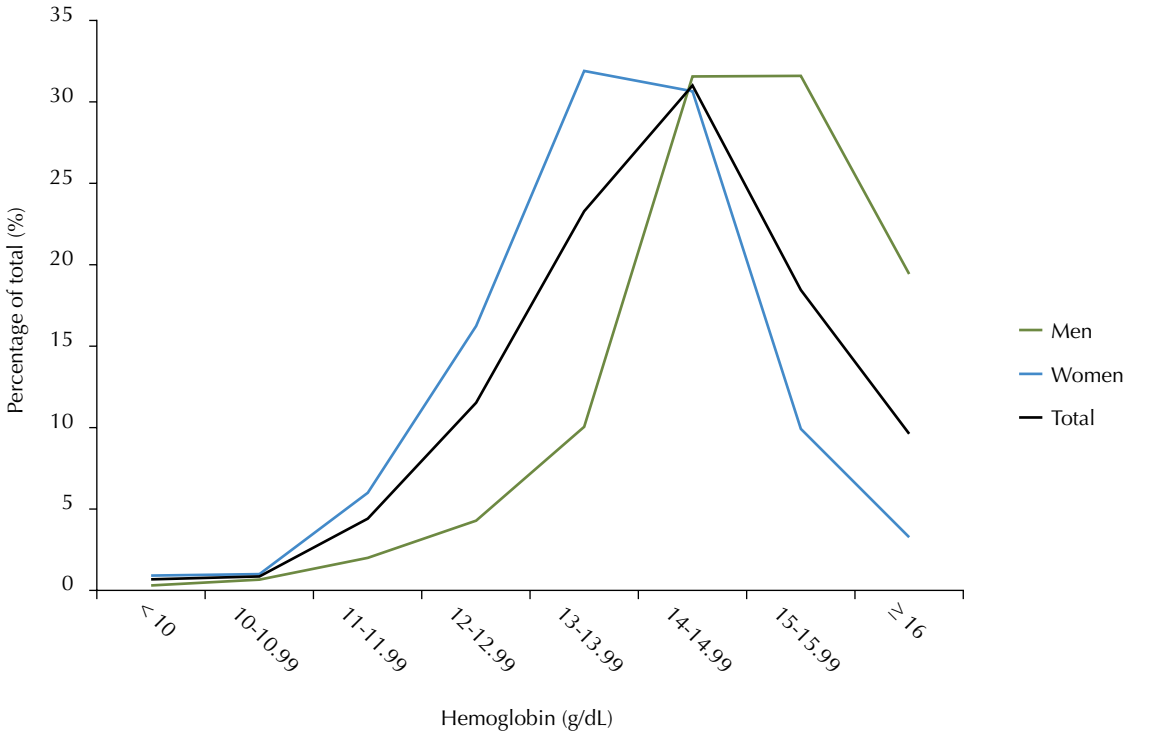

Figure 2. Distribution of hemoglobin levels in older adults by gender. SABE study, Sao Paulo, SP, Southeastern Brazil, 2010.

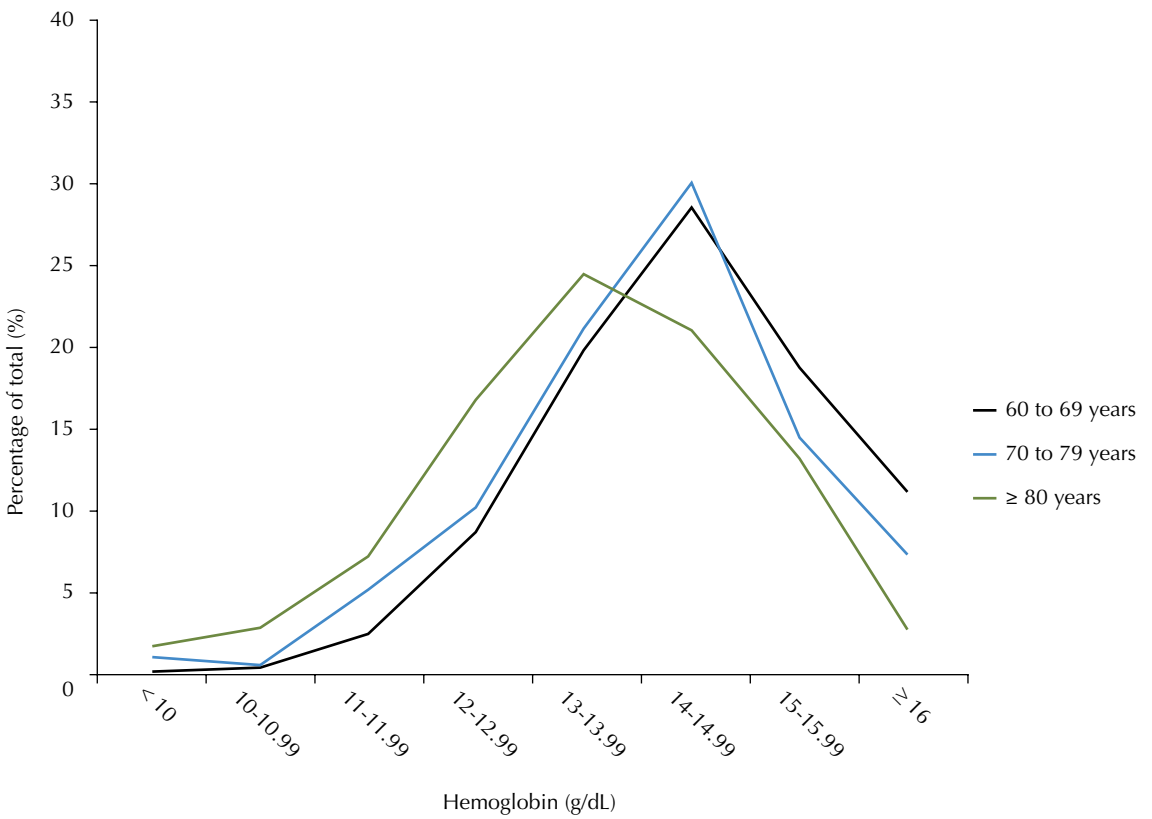

Figure 3. Distribution of hemoglobin levels in older adults by age group. SABE study, Sao Paulo, SP, Southeastern Brazil, 2010.

Table 2. Factors associated with the presence of anemia in older adults in the hierarchical logistic regression model. SABE study, Sao Paulo, SP, Southeastern Brazil, 2010.

	Adjusted odds ratio	95%CI	p
Model 1 – Demographics			
Female	0.97	0.57;1.64	0.690
Age (years)	1.07	1.04;1.09	< 0.001
Education (years of schooling)	0.96	0.91;1.01	0.363
Model 2 – Clinical characteristics			
Cognitive decline	0.75	0.28;2.02	0.593
Encephalic vascular accident	1.98	0.98;4.20	0.053
Diabetes	2.30	1.33;4.00	0.003
Osteoporosis	1.15	0.72;1.83	0.429
Cancer	2.72	1.21;6.11	0.024
Depression symptoms	1.75	1.06;2.88	0.030
Body mass index (kg/m^2)	0.97	0.91;1.04	0.436

In the present study, the prevalence of anemia was higher in older adults aged ≥ 80 years, which corroborates with the findings of Guralnik et al[10] (2004). Approximately 8.0% of older adults aged 65-74 years and 20.0%-26.0% of older adults aged ≥ 85 years in the USA had anemia in 2004. In contrast, our results showed a prevalence rate of approximately 17.0% in older adults aged ≥ 80 years.

A few mechanisms can explain the correlation between prevalence of anemia and advanced age. The first is the increased erythropoietin (EPO) demand. Healthy older adults appear to have increased EPO levels to meet the increased demand. In other cases, the decreased capacity of renal hormone production leads to the development of anemia. Furthermore, aging is associated with increased expression of pro-inflammatory cytokines, which can contribute to EPO insensitivity. Thus, genetic variation in the expression of these cytokines can influence anemia development in older adults by the induction of hepcidin expression (inflammation-related anemia) and suppression of the formation of erythroid colonies by cytokines.[23]

Among all factors examined, only age remained significantly associated with anemia in the first group in the hierarchical multiple regression model. Age continued to be significant even after inclusion of the clinical variables group, which showed an independent effect even after the main diseases associated with anemia were controlled.

The presence of diabetes, depression symptoms, and cancer remained significantly associated with anemia.

Diabetes is one of the main causes of chronic renal insufficiency. Even at subclinical stages, diabetes is responsible for a considerable portion of cases of anemia in older adults due to reduction of EPO secretion.[7,13] Approximately 12.0% of anemia cases in the USA are associated with renal disease.[10]

Cancer is an important risk factor for anemia, particularly when it affects the digestive system, because it causes intermittent bleeding (generally unnoticeable), which leads to anemia.[2] Another mechanism is the decreased response to EPO, mainly during chemotherapy.[14]

The association between anemia and depression was investigated in older adults. Such association had two possible directions of causality: anemia can lead to depression, but it can also be a consequence of depression. Anemia can lead to depression because of deficiencies of vitamins such as folate and vitamin B12, which cause a decrease in S-adenosyl-methionine production or an increase in homocysteine production. S-adenosyl-methionine functions as a cofactor in the synthesis of neurotransmitters including serotonin, and homocysteine accumulation can affect central nervous system receptors.[17] In an Italian study, Onder et al[15] found an association between depression and a significantly increased risk for anemia (OR = 1.93). This result persisted even after exclusion of vitamin B12 deficiency and exclusion of patients with relevant comorbidities.[15] According to a study performed in Taiwan, anemia and marginal vitamin B6 deficiency were significantly associated with the presence of depression symptoms as well as the coexistence of anemia with low levels of vitamin B6 and folate.[17]

Depression can also play a role in the development of anemia. Fatigue and lack of interest in performing daily activities (such as shopping and cooking), which are common depression symptoms, can affect the quality of nutrition of older adults, facilitating the development of anemia. Malnutrition is a common condition among depressed individuals.[15]

This study has a few limitations. It is not possible to determine the direction of the associations because this is a cross-sectional analysis. In addition, there are no data regarding other biological markers that could be

important in determining the causes of anemia, particularly IL-6, folate, and vitamin B12.

Healthcare professionals should focus on diagnosing and treating anemia in older adults, particularly when it is associated with other health conditions such as diabetes, cancer, and depression. Anemia can be easily diagnosed and markedly affects the health of older adults. Its reversal may play an important role in improving the quality of life of this population.

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