



Iron Deficiency Anemia in Older Females: A Comparison Between Community-Dwelling Individuals and Nursing Home Residents in the Southwest of Iran

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Abstract

Background: Iron deficiency anemia (IDA), as one of the most common problems of the elderly, is preventable and treatable.

Objectives: The current study aimed at determining the prevalence of IDA and its related factors in older females and comparing it between community-dwelling individuals and nursing home residents in the Southwest of Iran.

Methods: The current cross sectional study was conducted on 365 community-dwelling and nursing home residents in Bushehr Province, Iran. Data were collected in 2017. Blood samples were taken from all participants to measure hemoglobin and ferritin levels. Hemoglobin values less than 12 g/dL were considered as diagnostic criteria for anemia. Simple logistic regression was used to compare normal subjects with the ones with anemia, and after adjusting the marital status and age, the odds ratio (OR) was obtained. Furthermore, independent variables affecting them and ORs and their associated confidence intervals (CIs) were obtained, which were significant. Data were analyzed using SPSS software and the significant level was less than 0.05.

Results: The mean \pm SD age of participants was 82.00 ± 5.79 years, and the means of hemoglobin and ferritin levels were 12.6 ± 1.04 g/dL and 15.00 ± 5.11 μ g/dL, respectively. Based on the hemoglobin rate, 30% of the elderly females had anemia, and the prevalence of IDA in the elderly living in the community and nursing homes was 27% and 39%, respectively.

Conclusions: The prevalence of IDA in elderly females was high in Southwest of Bushehr. The crude and adapted ORs indicated that living in the nursing home was a risk factor for anemia. Therefore, this ailment requires a national screening, diagnosis, and early intervention.

Keywords: Elderly, Anemia, Iron Deficiency, Hemoglobin, Nursing Homes, Prevalence

1. Background

Anemia is a significant health problem worldwide in all age groups. According to the World Health Organization (WHO), 24.8% of the world's population is affected by anemia (1). The prevalence of anemia increases with age, especially at the beginning of aging; however, it accelerates from 80 years (2-4). Elderly population is growing worldwide, especially in the developing countries such as Iran, which are not yet ready for the challenges of this population increase (5). WHO defines the index of anemia as hemoglobin (Hb) less than 13 g/dL in males and less than 12 g/dL in females (6, 7). Anemia is more common in females and according to WHO, its global prevalence is 21% - 80% in them (8). Generally, the prevalence of anemia in

community-dwelling elderly is 12%, in hospitalized ones is 40%, and in nursing home residents (NHR) is 47% (9).

In general, age-related physiological changes, reduced food intake, multiple underlying diseases, and inadequate nutritional care are among the main causes of anemia in the elderly (10). According to WHO, 40% - 89% of female cases diagnosed with anemia are associated with the iron deficiency, and according to studies, 40% of anemic cases are female elderlies living in nursing homes (11), which inadequate iron intake and/or chronic loss of iron due to gastrointestinal bleeding are the main causes of this complication. In general, among nursing home residents, iron deficiency anemia (IDA) is more related to the loss of blood than lack of nutrients (6, 12).

Although anemia is not a disease, it is a symptom of

underlying illness that can affect cardiovascular function, physical activity, mobility and movement, risk of falling, hospitalization, disability, and mortality. In addition, it increases the risk of frailty syndrome, depression, delirium, and cognitive impairment, and affects the quality of life in the elderly (11, 13-21). In other words, the probability of hospitalization in older patients with anemia living in nursing homes is twice more than that of their peers without this complication (6).

In older adults, anemia is asymptomatic and usually occurs in the early stage of a disease (6). Compared to youth, fatigue and other common symptoms of anemia are less common in the elderly; therefore, the onset of anemia in the elderly is hidden and their complaints of anemia are often ignored (22). Despite the high prevalence of anemia in the elderly, this complication often remains undiagnosed and untreated (23).

Due to the high prevalence of anemia in the older adults, its association with underlying diseases, and its direct impact on the health of individuals, this complication is an area of interest in clinical research (24). Regarding the high prevalence of anemia in nursing home residents, the International Association of Gerontology and Geriatrics emphasizes the need for research on the prevalence of this condition and its early diagnosis and treatment in the elderly living in such places (25).

The prevalence of anemia is reported based on the impact of climatic, social, economic, and cultural conditions in the region (26). In Iran, only a few studies are conducted on the prevalence of this complication in certain groups such as those with cardiovascular and chronic kidney diseases (27). Considering the lack of epidemiological studies on anemia in older adults, and that so far no studies in Iran compared the prevalence of anemia among the elderly living in nursing homes and community, the current study is of higher significance. The results of these studies can be used in order to better plan for diagnosis and treatment of this condition.

2. Objectives

The present study aimed at comparing the prevalence of IDA among elderly females living in nursing homes and community in Iran and its effective factors.

3. Methods

3.1. Design and Participants

The current cross sectional study was conducted on elderly females living in nursing homes and community in

Bushehr Province, Iran from July to November 2017. The inclusion criteria of the study were: age over 60, female gender, having a file in the Welfare Organization of Bushehr, signing informed consent to participate in the study, and lack of iron supplementation, and for seniors living in nursing homes, other criteria were at least one year of residency in the nursing home and absence of anemia at the study onset. Bushehr Province is located in Southwest of Iran. There are two nursing homes, in Bushehr and Borazjan cities. In the current study, all elderly females living in nursing homes of Bushehr Province were selected by a complete sampling method. The total population of the elderly females living in the two nursing homes supervised by the Welfare Organization was 180; after the application of the exclusion criteria, 41 subjects remained and the sample size was 324.

The sample size was determined according to the study by Alizadehasl et al. (27). It should be noted that the two groups were matched by social class. In the study, a demographic information form including age, duration of living in the nursing home, marital status, and the number of children was used.

After obtaining the necessary permissions from the Ethics Committee of Bushehr University of Medical Sciences (ethics code: b-93-16-2) and the Welfare Organization of Bushehr Province, and getting informed consent from the elderly or their legal guardians, 5 mL clot and 1.5 mL oxalate samples were taken from each subject by a specialist and after observation of the cold cycle were transferred to Sina Lab in Bushehr city to measure serum ferritin, hemoglobin, and C-reactive protein (CRP) levels. Ferritin level of samples was measured by ELISA (the enzyme-linked immunosorbent assay) technique using a MAN kit, and hemoglobin by Sysmex K1000. Since in case of the positivity of CRP, ferritin is overestimated, all elderly patients with positive CRP were excluded. Based on the WHO diagnostic criteria, hemoglobin values less than 12 g/dL were considered as anemia (7). Anemia classification based on hemoglobin level consists of less than 8 g/dL as severe, 8 - 10 g/dL as moderate, and greater than 10 g/dL as mild (28).

3.2. Statistical Analysis

The prevalence of anemia was estimated according to place of residence (nursing home vs. community). The data were analyzed by SPSS version 21 (IBM, New York, USA) software using descriptive statistics (mean and standard deviation). In order to investigate the normality of data distribution, the Kolmogorov-Smirnov test was used. In the current study, the significance level was less than 0.05. To compare anemic and normal individuals, the simple logistic regression was used and after adaptation to the mar-

ital status and age, the adapted OR was obtained. Also, in order to compare older adults living in nursing

homes and community and the independent variables affecting them, the simple logistic regression was used and ORs, CIs associated with their use, and their significance levels were achieved.

4. Results

A total of 365 elderly females participated in the study, among which 41 (11.2%) were nursing home residents. The mean \pm SD age of participants was 82.00 ± 5.79 years and 8% were single. The mean hemoglobin and ferritin levels in the participants were 12.6 ± 1.04 g/dL and 15.00 ± 5.11 μ g/dL, respectively. Demographic data of the older adults are shown in [Table 1](#).

Based on the amount of ferritin, more than half of the participants had anemia, but based on hemoglobin level, 30% of them had anemia, while only 6.01% had moderate anemia; therefore, the overall prevalence of IDA in the community-dwelling older adults (CDOA) and nursing home residents was 39% and 27%, respectively.

More than 68% of older adults lived in the nursing homes for less than two years. The crude and adapted ORs indicated that living in nursing homes was a risk factor for anemia (OR = 8.69, 95% CI = 3.28 - 23.03) ([Table 1](#)).

According to [Table 2](#), the age of the participants living in nursing homes was significantly less than that of the community-dwelling subjects (OR = 0.94, 95% CI = 0.89 - 0.99). On the other hand, with the increase in age, the risk of anemia increases; therefore, according to the results of [Table 3](#), hemoglobin and ferritin levels significantly decreased with age.

In addition, based on the amount of hemoglobin (OR = 0.60, 95% CI = 0.44 - 0.82) or ferritin (OR = 0.68; 95% CI = 0.60 - 0.77), community-dwelling can be a preventive factor for anemia ([Table 2](#)). Another finding was that there was no significant relationship between marital status and living in nursing home. Meanwhile, having children, especially female, had a direct relationship with staying at nursing home (OR = 0.48; 95% CI = 0.38 - 0.60) ([Table 2](#)).

5. Discussion

IDA is a common complication in elderly females, especially the ones living in nursing homes, which prone the elderlies to disability and mortality. This is one of the first studies in Iran that compared the prevalence of IDA between elderly females living in nursing homes and community. In epidemiological studies, the most applicable

definition for anemia in elderly females was hemoglobin level less than 12 g/dL ([13](#)) that was also considered in the current study. Anemia prevalence varies depending on environmental factors and the population and location under study ([29](#)). The reported prevalence of IDA in older people varies from 2.5% to 55%. IDA can be caused by blood loss, malignancy, or decreases in iron intake or iron absorption ([29](#)). Accordingly, the overall prevalence of anemia in females under study was 30% (28% in community dwellers and 39% in nursing home residents), which was different from the rate reported by Cecchi et al. ([30](#)), in Italy (24%) among the community-dwelling older females, Yusof et al. ([31](#)), in Malaysia (37.5%), Callera et al. ([32](#)), in the Southeastern Brazil (17.6%), Westerlind et al. ([33](#)), in Sweden (32%) among elderly females living in nursing homes, Chan et al. ([34](#)), in China (65%) and Sahin et al. ([29](#)), in Turkey (55%). Contradiction between the results can be related to differences in the populations studied, the criteria used to define the anemia, and the studies design.

Another result of the current study was the higher prevalence of IDA in the elderly females who lived in nursing homes compared to the elderly community dwellers, since in Bushehr, due to the cultural taboos of taking the elderly to the nursing home, they are only taken to such places when they live in desperately poor conditions and have comorbidities ([35](#)); hence, the higher prevalence of IDA can be explained in this group. In addition, living in the nursing home affects the nutritional status, mobility, and vulnerability of the residents, which exposes them to the risk of IDA; consistent with the results of the present study ([29, 34, 36-39](#)).

In the current study, the level of hemoglobin and ferritin decreased with age, and in particular in the nursing home residents caused by several reasons, including reduced erythropoietin secretion, reduced hematopoietic reserve, decreased intake of iron and vitamins, and the chronic illnesses that occur with chronic inflammatory diseases ([30](#)). The results of the current study were consistent with those of other studies ([3, 4, 9, 13, 15, 29, 31, 33](#)).

5.1. Strengths and Limitations

The strength of the current study was its being among one of the first studies to compare the prevalence of IDA between the elderly female community-dwellers and nursing home residents, and it had limitations such as small sample size of the subjects living in nursing homes (especially that only females were included), and disregarding the impact of underlying diseases, nutritional status, and residency time on IDA incidence. All these can be ascertained from a longitudinal study.

Table 1. Characteristics of the Elderly Participants in Bushehr Province in Terms of Anemia^a

	Without Anemia (N = 258)	Mild Anemia (N = 84)	Moderate Anemia (N = 22)	With Anemia (N = 106) ^b	Crude Model		Adjusted Model ^c	
					OR (95% CI)	P Value ^d	OR (95% CI)	P Value ^d
Age, y	81.51 ± 5.87	83.61 ± 5.29	84.00 ± 5.47	5.30 ± 83.69	1.07 (1.02 - 1.11)	0.001	1.07 (1.02 - 1.11)	0.001
Hemoglobin level, g/dL	13.02 ± 0.66	11.55 ± 0.23	10.14 ± 0.58	0.66 ± 11.26	-	-	-	-
Number of children	5.90 ± 2.38	5.88 ± 2.24	6.09 ± 2.20	2.22 ± 5.92	1.00 (0.91 - 1.10)	0.936	0.97 (0.85 - 1.11)	0.675
Number of female children	3.32 ± 1.58	3.20 ± 1.50	3.09 ± 1.54	1.50 ± 3.17	0.94 (0.81 - 1.09)	0.429	0.87 (0.73 - 1.04)	0.874
Number of male children	2.61 ± 1.28	2.67 ± 1.31	3.13 ± 1.12	1.28 ± 2.77	0.29 (0.92 - 1.31)	0.290	1.10 (0.89 - 1.36)	0.352
Nursing home residency					1.65 (0.84 - 3.24)	0.141	1.93 (0.96 - 3.87)	0.065
No	233 (90.3)	75 (89.3)	15 (68.2)	90 (84.9)				
Yes	25 (9.7)	9 (10.7)	7 (31.8)	16 (15.1)				
Marital status					0.84 (0.34 - 2.05)	0.704	1.04 (0.41 - 2.60)	0.927
Married	238 (92.2)	79 (94.0)	20 (90.0)	99 (93.4)				
Single	20 (7.8)	5 (6.0)	2 (9.1)	7 (6.6)				
Duration of nursing home residency, y					1.37 (0.99 - 1.90)	0.054	1.51 (1.07 - 2.13)	0.016
No	233 (90.3)	75 (89.3)	15 (68.2)	90 (84.9)				
1	6 (2.3)	2 (2.4)	1 (4.5)	3 (2.8)				
2	18 (7.0)	6 (7.1)	3 (13.6)	9 (8.5)				
3	1 (0.4)	1 (1.2)	2 (9.1)	3 (2.8)				
4	-	-	1 (4.5)	1 (0.9)				

Abbreviations: CI, confidence interval; OR, odds ratio; SD, standard deviation.

^aValues are expressed as mean ± SD or No. (%).

^bAdjusted based on age and marital status

^cNumber of patients without anemia was the baseline for comparison.

^dP < 0.05 was considered significant.

Due to the prevalence and importance of anemia in the elderly, especially the ones living in nursing homes, it is helpful to conduct further studies on the causes and risk factors of this complication and develop local guidelines to control it.

5.2. Conclusions

The current study results showed that IDA was one of the problems of elderly females, especially the nursing home residents, which confirmed the results of studies in other countries. Due to the health consequences and risk of mortality in elderly females with reduced hemoglobin, this index is recommended to be monitored on a regular basis. A national plan for screening and timely treatment of the elderly community dwellers and the ones referring

to health houses should be undertaken to prevent complications such as frailty and disability in this group.

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Footnotes

Authors' Contribution: Concept and design: Eisa Safavi, Akram Farhadi, Leila Sadeghmoghaddam, and Maryam Marzban. Acquisition of subjects and/or data: Eisa Safavi. Analysis and interpretation of data: Maryam Marzban and Akram Farhadi. Preparation of manuscript: Eisa Safavi,

Table 2. Characteristics of the Elderly Living in Nursing Homes or Community^a

Variable	All (N = 365)	NHR (N = 41)	CDOA (N = 324)	OR (95% CI)	P Value ^b
Age, y	82.16 ± 5.79	80.44 ± 6.61	82.38 ± 5.65	0.94 (0.89 - 0.99)	0.045
Age groups, y				0.61 (0.35 - 1.05)	0.077
60 - 69	13 (3.6)	4 (9.8)	9 (2.8)		
70 - 79	125 (34.2)	15 (36.6)	110 (34.0)		
≥ 80	227 (62.2)	22 (53.7)	205 (63.3)		
Marital status					
Single	27 (7.4)	6 (14.6)	21 (6.5)	2.47 (0.93 - 6.54)	0.068
Married	338 (92.6)	35 (85.4)	303 (93.5)		
Number of children	5.91 ± 2.33	4.53 ± 2.39	6.08 ± 2.26	0.79 (0.70 - 0.89)	0.0001
Number of female children	3.27 ± 1.55	1.68 ± 1.23	3.48 ± 1.47	0.48 (0.38 - 0.60)	0.0001
Number of male children	2.66 ± 1.28	2.87 ± 1.51	2.63 ± 1.25	1.16 (0.89 - 1.50)	0.263
Hemoglobin, g/dL	12.51 ± 1.04	12.00 ± 1.05	12.57 ± 1.02	0.60 (0.44 - 0.82)	0.001
Normal (≥ 120)	258 (70.0)	25 (61.0)	233 (71.9)		
Mild (110 - 119)	84 (23.9)	9 (22.0)	75 (23.1)		
Moderate (80 - 109)	22 (6.01)	7 (17.1)	15 (4.6)		
Severe (< 80)	-	-	-		
Serum ferritin, μg/L	15.71 ± 5.11	11.13 ± 3.15	16.28 ± 5.02	0.68 (0.60 - 0.77)	0.0001

Abbreviations: CI, confidence interval; OR, odds ratio; SD, standard deviation.

^aAbbreviations: Values are expressed as mean ± SD or No. (%).

^bP < 0.05 was considered significant.

Table 3. IDA Parameters in the Studied Elderly Based on Age^a

Variable	NHR (N = 41)	CDOA (N = 324)	OR (95% CI)	P Value ^b
Hemoglobin, g/dL			0.60 (0.44 - 0.82)	0.001
60 - 69	11.85 ± 1.36	13.23 ± 0.99		
70 - 79	12.26 ± 0.92	12.70 ± 0.84		
≥ 80	11.85 ± 1.09	12.47 ± 1.09		
Serum ferritin, μg/L			0.68 (0.60 - 0.77)	0.00001
60 - 69	12.5 ± 1.91	17.42 ± 8.60		
70 - 79	11.42 ± 3.22	16.54 ± 4.38		
≥ 80	10.68 ± 3.28	16.10 ± 5.16		

^aAbbreviations: CDOA, community-dwelling older adults; CI, confidence interval; NHR, nursing home residents; OR, odds ratio; SD, standard deviation.

^bValues are expressed as mean ± SD.

^cP < 0.05 was considered significant.

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Conflict of Interests: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Ethics Committee of Bushehr University of Medical Sciences

(ethics code: b.93.16.2). Written informed consent was obtained from all participants. If the participant could not understand the information and give informed consent due to cognitive impairment, it was obtained from his/her legal guardians. All the procedures were in accordance with the ethical standards of the institutional and/or national research committee as well as the principles of the Declaration of Helsinki 1964 and its revision or comparable ethical standards.

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References

- McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993-2005. *Public Health Nutr.* 2009;12(4):444-54. doi: [10.1017/S1368980008002401](https://doi.org/10.1017/S1368980008002401). [PubMed: [18498676](https://pubmed.ncbi.nlm.nih.gov/18498676/)].
- Fleming DJ, Jacques PF, Tucker KL, Massaro JM, D'Agostino RS, Wilson PW, et al. Iron status of the free-living, elderly Framingham Heart Study cohort: An iron-replete population with a high prevalence of elevated iron stores. *Am J Clin Nutr.* 2001;73(3):638-46. doi: [10.1093/ajcn/73.3.638](https://doi.org/10.1093/ajcn/73.3.638). [PubMed: [11237943](https://pubmed.ncbi.nlm.nih.gov/11237943/)].
- Guralnik JM, Eisenstaedt RS, Ferrucci L, Klein HG, Woodman RC. Prevalence of anemia in persons 65 years and older in the United States: evidence for a high rate of unexplained anemia. *Blood.* 2004;104(8):2263-8. doi: [10.1182/blood-2004-05-1812](https://doi.org/10.1182/blood-2004-05-1812). [PubMed: [15238427](https://pubmed.ncbi.nlm.nih.gov/15238427/)].
- Terrier B, Resche-Rigon M, Andres E, Bonnet F, Hachulla E, Marie I, et al. Prevalence, characteristics and prognostic significance of anemia in daily practice. *QJM.* 2012;105(4):345-54. doi: [10.1093/qjmed/hcr230](https://doi.org/10.1093/qjmed/hcr230). [PubMed: [2219918](https://pubmed.ncbi.nlm.nih.gov/2219918/)].
- United Nations. *World population ageing*. New York: Department of Economic and Social Affairs Population Division United Nations 2015; 2015. Available from: <http://www.un.org/en/sections/issues-depth/ageing>.
- Eisenstaedt R, Penninx BW, Woodman RC. Anemia in the elderly: Current understanding and emerging concepts. *Blood Rev.* 2006;20(4):213-26. doi: [10.1016/j.blre.2005.12.002](https://doi.org/10.1016/j.blre.2005.12.002). [PubMed: [16472893](https://pubmed.ncbi.nlm.nih.gov/16472893/)].
- World Health Organization. *Nutritional anaemias: Report of a WHO scientific group*. Geneva: WHO; 1968.
- World Health Organization. *The global prevalence of anaemia in 2011*. 2015. Available from: http://www.who.int/nutrition/publications/micronutrients/global_prevalence_anaemia_2011/en/.
- Gaskell H, Derry S, Andrew Moore R, McQuay HJ. Prevalence of anaemia in older persons: Systematic review. *BMC Geriatr.* 2008;8:1. doi: [10.1186/1471-2318-8-1](https://doi.org/10.1186/1471-2318-8-1). [PubMed: [18194534](https://pubmed.ncbi.nlm.nih.gov/18194534/)]. [PubMed Central: [PMC2248585](https://pubmed.ncbi.nlm.nih.gov/PMC2248585/)].
- Cereda E, Pedrolli C, Zagami A, Vanotti A, Piffer S, Opizzi A, et al. Body mass index and mortality in institutionalized elderly. *J Am Med Dir Assoc.* 2011;12(3):174-8. doi: [10.1016/j.jamda.2010.11.013](https://doi.org/10.1016/j.jamda.2010.11.013). [PubMed: [21333917](https://pubmed.ncbi.nlm.nih.gov/21333917/)].
- Sabol VK, Resnick B, Galik E, Gruber-Baldini AL, Gonce Morton P, Hicks GE. Anemia evaluation and management in nursing home residents. *West J Nurs Res.* 2010;32(4):447-61. doi: [10.1177/0193945909353899](https://doi.org/10.1177/0193945909353899). [PubMed: [20685904](https://pubmed.ncbi.nlm.nih.gov/20685904/)].
- Artz AS, Fergusson D, Drinka PJ, Gerald M, Bidenbender R, Lechich A, et al. Mechanisms of unexplained anemia in the nursing home. *J Am Geriatr Soc.* 2004;52(3):423-7. doi: [10.1111/j.1532-5415.2004.52116.x](https://doi.org/10.1111/j.1532-5415.2004.52116.x). [PubMed: [14962159](https://pubmed.ncbi.nlm.nih.gov/14962159/)].
- Bach V, Schruckmayer G, Sam I, Kemmler G, Stauder R. Prevalence and possible causes of anemia in the elderly: A cross-sectional analysis of a large European University Hospital cohort. *Clin Interv Aging.* 2014;9:1187-96. doi: [10.2147/CIAS.S61125](https://doi.org/10.2147/CIAS.S61125). [PubMed: [25092968](https://pubmed.ncbi.nlm.nih.gov/25092968/)]. [PubMed Central: [PMC4113572](https://pubmed.ncbi.nlm.nih.gov/PMC4113572/)].
- Bross MH, Soch K, Smith-Knuppel T. Anemia in older persons. *Am Fam Physic.* 2010;82(5):480-7.
- Contreras Mdel M, Formiga F, Ferrer A, Chivite D, Padros G, Montero A, et al. [Profile and prognosis of patients over 85 years old with anemia living in the community. Octabaix Study]. *Rev Esp Geriatr Gerontol.* 2015;50(5):211-5. doi: [10.1016/j.regg.2014.11.004](https://doi.org/10.1016/j.regg.2014.11.004). [PubMed: [25583243](https://pubmed.ncbi.nlm.nih.gov/25583243/)].
- Foroughan M, Delbari A, Said SE, AkbariKamrani AA, Rashedi V, Zandi T. Risk factors and clinical aspects of delirium in elderly hospitalized patients in Iran. *Aging Clin Exp Res.* 2016;28(2):313-9. doi: [10.1007/s40520-015-0400-x](https://doi.org/10.1007/s40520-015-0400-x). [PubMed: [26194422](https://pubmed.ncbi.nlm.nih.gov/26194422/)].
- Hong CH, Falvey C, Harris TB, Simonsick EM, Satterfield S, Ferrucci L, et al. Anemia and risk of dementia in older adults: Findings from the Health ABC study. *Neurology.* 2013;81(6):528-33. doi: [10.1212/WNL.0b013e31829e701d](https://doi.org/10.1212/WNL.0b013e31829e701d). [PubMed: [23902706](https://pubmed.ncbi.nlm.nih.gov/23902706/)]. [PubMed Central: [PMC3775683](https://pubmed.ncbi.nlm.nih.gov/PMC3775683/)].
- Juarez-Cedillo T, Basurto-Acevedo L, Vega-Garcia S, Manuel-Apolinar L, Cruz-Tesoro E, Rodriguez-Perez JM, et al. Prevalence of anemia and its impact on the state of frailty in elderly people living in the community: SADEM study. *Ann Hematol.* 2014;93(12):2057-62. doi: [10.1007/s00277-014-2155-4](https://doi.org/10.1007/s00277-014-2155-4). [PubMed: [25005679](https://pubmed.ncbi.nlm.nih.gov/25005679/)].
- Ng TP, Feng L, Nyunt MS, Larbi A, Yap KB. Frailty in older persons: multisystem risk factors and the frailty risk index (FRI). *J Am Med Dir Assoc.* 2014;15(9):635-42. doi: [10.1016/j.jamda.2014.03.008](https://doi.org/10.1016/j.jamda.2014.03.008). [PubMed: [24746590](https://pubmed.ncbi.nlm.nih.gov/24746590/)].
- Son SJ, Lee KS, Na DL, Seo SW, Kim CH, Kim JH, et al. Anemia associated with depressive symptoms in mild cognitive impairment with severe white matter hyperintensities. *J Geriatr Psychiatry Neurol.* 2011;24(3):161-7. doi: [10.1177/0891988711417132](https://doi.org/10.1177/0891988711417132). [PubMed: [21856970](https://pubmed.ncbi.nlm.nih.gov/21856970/)].
- Zakai NA, French B, Arnold AM, Newman AB, Fried LF, Robbins J, et al. Hemoglobin decline, function, and mortality in the elderly: The cardiovascular health study. *Am J Hematol.* 2013;88(1):5-9. doi: [10.1002/ajh.23336](https://doi.org/10.1002/ajh.23336). [PubMed: [23044913](https://pubmed.ncbi.nlm.nih.gov/23044913/)]. [PubMed Central: [PMC3860593](https://pubmed.ncbi.nlm.nih.gov/PMC3860593/)].
- Lipschitz D. Medical and functional consequences of anemia in the elderly. *J Am Geriatr Soc.* 2003;51(3 Suppl):S10-3. doi: [10.1046/j.1532-5415.51.3s.6.x](https://doi.org/10.1046/j.1532-5415.51.3s.6.x). [PubMed: [12588566](https://pubmed.ncbi.nlm.nih.gov/12588566/)].
- Sabol VK, Resnick B, Galik E, Gruber-Baldini A, Morton PG, Hicks GE. Anemia and its impact on function in nursing home residents: What do we know? *J Am Acad Nurse Pract.* 2010;22(1):3-16. doi: [10.1111/j.1745-7599.2009.00471.x](https://doi.org/10.1111/j.1745-7599.2009.00471.x). [PubMed: [20074191](https://pubmed.ncbi.nlm.nih.gov/20074191/)].
- Pandya N, Bookhart B, Mody SH, Funk Orsini PA, Reardon G. Study of anemia in long-term care (SALT): Prevalence of anemia and its relationship with the risk of falls in nursing home residents. *Curr Med Res Opin.* 2008;24(8):2139-49. doi: [10.1185/03007990802215844](https://doi.org/10.1185/03007990802215844). [PubMed: [18561876](https://pubmed.ncbi.nlm.nih.gov/18561876/)].
- Tolson D, Rolland Y, Andrieu S, Aquino JP, Beard J, Benetos A, et al. International Association of Gerontology and Geriatrics: A global agenda for clinical research and quality of care in nursing homes. *J Am Med Dir Assoc.* 2011;12(3):184-9. doi: [10.1016/j.jamda.2010.12.013](https://doi.org/10.1016/j.jamda.2010.12.013). [PubMed: [21333919](https://pubmed.ncbi.nlm.nih.gov/21333919/)].
- Miller JL. Iron deficiency anemia: A common and curable disease. *Cold Spring Harb Perspect Med.* 2013;3(7). doi: [10.1101/cshperspect.a011866](https://doi.org/10.1101/cshperspect.a011866). [PubMed: [23613366](https://pubmed.ncbi.nlm.nih.gov/23613366/)]. [PubMed Central: [PMC3685880](https://pubmed.ncbi.nlm.nih.gov/PMC3685880/)].
- Alizadehasl A, Golmohammadi Z, Panjavi L, Mahmoodmoradi S, Azarfarin R. The incidence of anaemia in adult patients with cardiovascular diseases in northwest Iran. *J Pak Med Assoc.* 2011;61(11):1091-5. [PubMed: [22125985](https://pubmed.ncbi.nlm.nih.gov/22125985/)].
- World Health Organization. *Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity*. 2011. Available from: <http://www.who.int/iris/handle/10665/85839>.
- Sahin S, Tasar PT, Simsek H, Cicek Z, Eskiizmirli H, Aykar FS, et al. Prevalence of anemia and malnutrition and their association in elderly nursing home residents. *Aging Clin Exp Res.* 2016;28(5):857-62. doi: [10.1007/s40520-015-0490-5](https://doi.org/10.1007/s40520-015-0490-5). [PubMed: [26572155](https://pubmed.ncbi.nlm.nih.gov/26572155/)].

30. Cecchi F, Pancani S, Vannetti F, Boni R, Castagnoli C, Paperini A, et al. Hemoglobin concentration is associated with self-reported disability and reduced physical performance in a community dwelling population of nonagenarians: The Mugello Study. *Intern Emerg Med*. 2017;**12**(8):1167-73. doi: [10.1007/s11739-017-1762-1](https://doi.org/10.1007/s11739-017-1762-1). [PubMed: [29071662](https://pubmed.ncbi.nlm.nih.gov/29071662/)]. [PubMed Central: [PMC5691100](https://pubmed.ncbi.nlm.nih.gov/PMC5691100/)].
31. Yusof M, Awaluddin SM, Omar M, Ahmad NA, Abdul Aziz FA, Jamaluddin R, et al. Prevalence of anaemia among the elderly in Malaysia and its associated factors: Does ethnicity matter? *J Environ Public Health*. 2018;**2018**:1803025. doi: [10.1155/2018/1803025](https://doi.org/10.1155/2018/1803025). [PubMed: [29853924](https://pubmed.ncbi.nlm.nih.gov/29853924/)]. [PubMed Central: [PMC5949179](https://pubmed.ncbi.nlm.nih.gov/PMC5949179/)].
32. Callera F, Callera AF, da Silva AM, Rosa ES. Prevalence of anemia in a sample of elderly southeastern Brazilians. *Rev Bras Hematol Hemoter*. 2015;**37**(1):43-7. doi: [10.1016/j.bjhh.2014.06.005](https://doi.org/10.1016/j.bjhh.2014.06.005). [PubMed: [25638767](https://pubmed.ncbi.nlm.nih.gov/25638767/)]. [PubMed Central: [PMC4318851](https://pubmed.ncbi.nlm.nih.gov/PMC4318851/)].
33. Westerlind B, Ostgren CJ, Molstad S, Midlov P. Prevalence and predictive importance of anemia in Swedish nursing home residents - a longitudinal study. *BMC Geriatr*. 2016;**16**(1):206. doi: [10.1186/s12877-016-0375-2](https://doi.org/10.1186/s12877-016-0375-2). [PubMed: [27912734](https://pubmed.ncbi.nlm.nih.gov/27912734/)]. [PubMed Central: [PMC5134278](https://pubmed.ncbi.nlm.nih.gov/PMC5134278/)].
34. Chan TC, Yap DY, Shea YF, Luk JK, Chan FH, Chu LW. Prevalence of anemia in Chinese nursing home older adults: Implication of age and renal impairment. *Geriatr Gerontol Int*. 2013;**13**(3):591-6. doi: [10.1111/j.1447-0594.2012.00942.x](https://doi.org/10.1111/j.1447-0594.2012.00942.x). [PubMed: [22994890](https://pubmed.ncbi.nlm.nih.gov/22994890/)].
35. Farhadi A, Foroughan M, Mohammadi F, Rassouli M, Noroozian M, Nazari S, et al. Validity and reliability of the Persian version of the revised caregiving appraisal scale in Iranian family caregivers of older adults with dementia. *Iran Red Crescent Med J*. 2016;**19**(1). doi: [10.5812/ircmj.35141](https://doi.org/10.5812/ircmj.35141).
36. Artz AS, Fergusson D, Drinka PJ, Gerald M, Gravenstein S, Lechich A, et al. Prevalence of anemia in skilled-nursing home residents. *Arch Gerontol Geriatr*. 2004;**39**(3):201-6. doi: [10.1016/j.archger.2004.03.006](https://doi.org/10.1016/j.archger.2004.03.006). [PubMed: [15381339](https://pubmed.ncbi.nlm.nih.gov/15381339/)].
37. Silva EC, Roriz AK, Eickemberg M, Mello AL, Cortes EB, Feitosa CA, et al. Factors associated with anemia in the institutionalized elderly. *PLoS One*. 2016;**11**(9). e0162240. doi: [10.1371/journal.pone.0162240](https://doi.org/10.1371/journal.pone.0162240). [PubMed: [27607057](https://pubmed.ncbi.nlm.nih.gov/27607057/)]. [PubMed Central: [PMC5015845](https://pubmed.ncbi.nlm.nih.gov/PMC5015845/)].
38. Kalchthaler T, Tan ME. Anemia in institutionalized elderly patients. *J Am Geriatr Soc*. 1980;**28**(3):108-13. doi: [10.1111/j.1532-5415.1980.tb00242.x](https://doi.org/10.1111/j.1532-5415.1980.tb00242.x). [PubMed: [7354202](https://pubmed.ncbi.nlm.nih.gov/7354202/)].
39. Morley JE. Anemia in the nursing homes: A complex issue. *J Am Med Dir Assoc*. 2012;**13**(3):191-4. doi: [10.1016/j.jamda.2011.12.057](https://doi.org/10.1016/j.jamda.2011.12.057). [PubMed: [22261540](https://pubmed.ncbi.nlm.nih.gov/22261540/)].