Original Article

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Association between Anemia and Falls in the Elderly

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ABSTRACT

BACKGROUND AND OBJECTIVE: Falls are the major cause of disability, hospitalization and mortality in the elderly. Various risk factors such as anemia cause falls in the elderly. The present study was conducted to investigate the relationship between anemia and falls in the elderly in Amirkola.

METHODS: This cross-sectional study was conducted among people aged 60 years and above in Amirkola during a one-year period as a census. Complete blood count was performed based on fasting blood sample. History of falls and associated chronic diseases was confirmed based on the patient's report, doctor's prescription and the patient's medications. The cognitive status was measured using Mini Mental State Examination (MMSE) standard questionnaire, symptoms of depression were measured using Geriatric Depression Scale (GDS) standard questionnaire and the balance status was measured using Berg Balance Test (BBT) standard questionnaire.

FINDINGS: 1482 elderly individuals, including 817 men (55.1%) and 665 women (44.9%) were examined, among which 271 (18.3%) individuals experienced falls. 21.2% of people with anemia and 17.6% of people without anemia experienced falls, though the difference was not significant. Mean hemoglobin in all the participants as well as men (13.46 and 13.84 gr/dl, respectively) was less than people who did not experience falls (13.74 gr/dl, p=0.009 and 14.33 gr/dl, p=0.007, respectively). Based on logistic regression model, age of ≥75 (OR=1.81), depression (OR=1.84) and underlying diseases (OR=1.2) played the most significant role in increasing falls.

CONCLUSION: Results of the study demonstrated that there is no relationship between anemia and falls. However, after differentiating genders, decline in hemoglobin levels increased falls in the elderly men.

KEY WORDS: *The elderly, Anemia, Falls.*

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Introduction

Aging is a biological process, not a disease. According to the definition of World Health Organization, people older than 60 years old in developing countries and people older than 65 years old in developed countries are considered as the elderly. In this period of life, people are prone to various diseases and disabilities due to reduction in physiological capacities of body (1).

Falls is defined as sudden loss of balance while standing and falling on the ground or lower levels (2) and is an important cause of disability, hospitalization and mortality in the elderly (1). World Health Organization calls this issue the third cause of chronic disability in the elderly (3). There are several risk factors for falls in the elderly including: age (2), female gender (falls are more prevalent among women above 85 years old) (4), chronic disease, anemia, lower weight, history of falls within the past year (5), dependence on others for support in daily living activities, decreased blood pressure (6), drug therapy (neuropsychiatric drugs, antihypertensive drugs and anticonvulsants) (7), poly pharmacy (8), neurological problems, alcohol consumption (2), diabetes mellitus (2), confusion, cognitive impairment and muscle weakness (3), dizziness (6), visual impairment, urinary incontinence (5), inappropriate foot cover (4 and 2), living alone (4), depression and hypothyroidism (6). Some of these factors, such as environmental factors, can be corrected (10). If the treatable factors are identified and eliminated, we will observe 30% decline in the frequency of falls (11).

As the age increases, the frequency of chronic diseases increases. According to the definition of World Health Organization, anemia is referred to hemoglobin level lower than 13 g/dl in men and hemoglobin level lower than 12 g/dl in women. The prevalence of anemia in people above 65 years old is estimated to be 10 – 15% and as the age increases, the frequency of anemia increases (12, 13). The high prevalence of anemia in the elderly is due to concomitant diseases (14). There are several studies about the relationship between anemia and falls in the elderly. As the hemoglobin levels decrease, the risk of falls increases considerably (6, 15 – 18). In a study by Penninx et al., after modification of gender, age, body mass index and diseases, anemia was significantly associated with increased falls (14). According to the study of Pandya et al., anemia, neuropsychiatric drugs and age over 85 years was associated with double increase in the risk of falls (19). According to a study by Reardon et al. among residents of elderly care centers, undergoing medical treatment for anemia, people who have been treated with erythropoietin or darbepoetin alfa for their anemia revealed considerable decline in the frequency of falls (20). Considering the importance of falls and the prevalence of anemia in the elderly and considering that anemia is likely to be a modifiable cause of falling, the present study was conducted to analyze the relationship between anemia and falls in the elderly in Amirkola.

Methods

This cross – sectional study is a part of "The Amirkola Health and Aging Project (AHAP)", which is being conducted among all people aged 60 years and above in Amirkola (21). There are two health centers in Amirkola that have a list all elderly people and their addresses. The elderly were informed about the project by phone call or referring to their house and they were invited to participate and those who referred to The Health Research Center of Amirkola were included in the study. People whose information was incomplete or could not provide accurate information due to cognitive impairment were excluded from the study.

After obtaining permission from the Ethics Committee (MUBABOL.REC / 1394 / 22), the participants' information was collected in a 12-month period (2011 – 2012). The required data were collected by a trained researcher using various standard questionnaires and examinations. Demographic characteristics including age, gender and education level were obtained by asking the participants or their relatives. The history of falls was determined by the question "did you have an experience of falls within the past year?". The answers were "yes" or "no", and if the answer was positive, they were asked about the frequency of falls. Recurrent falls was defined as three

falls during one year or two falls during six months. Common ethical considerations, such as providing the patients with required descriptions, their willingness to participate in research, absence of any coercion for patients to participate in the research, confidentiality of the information obtained from them, publishing research results without mentioning the name and personal details were considered and informed written consent was obtained from all patients. Venous blood samples were collected after 12 hours of fasting status, while the person was in a sitting position, to determine hemoglobin level and blood indices and was measured using SYSMEX. The Body Mass Index was calculated as kilograms divided by height in meters squared and the concomitant chronic diseases were confirmed based on the patient's report, doctor's prescription and the patient's medications. The concomitant diseases included heart disease (angina, myocardial infarction, congestive heart failure); high blood pressure; diabetes; urinary incontinence; musculoskeletal (osteoporosis and osteoarthritis); vision problems; hearing impairment (self-reported or asking from relatives); stroke, Parkinson's disease; depression; chronic obstructive pulmonary disease, asthma and thyroid problems (hyperthyroidism, hypothyroidism).

The cognitive status was measured using Mini Mental State Examination (MMSE) questionnaire. The maximum and minimum MMSE score are 30 and 0, respectively. If the participants earn 25 or more points, they are considered normal. Scores 21 – 24, 10 – 20 and less than 9, indicate mild, moderate, and severe cognitive impairment, respectively (22). The symptoms of depression were measured using Geriatric Depression Scale (GDS) questionnaire. This questionnaire includes 15 questions, answered with "yes" or "no" (23). Based on this scale, depressive symptoms were considered into mild (5 – 8), moderate (9-11) and severe (12–15). The score less than 5 considered normal. The validity of the Persian version of this questionnaire has been verified (24).

The balance condition was measured using the Berg Balance Test (BBT) questionnaire. This questionnaire includes 14 items and the final score is between 0 and 56. Score 41 – 56 indicates low risk of falls, 21 – 40 indicate average risk of falls and score 0 – 20 indicate high risk of falls (25). Validity and reliability of the Persian version have been verified (26). In addition to the descriptive analysis, logistic regression model was used to find the possible role of different variables in the incidence of falls. Since normal hemoglobin levels are higher in men, all models were categorized according to gender to find the difference in the prevalence of falls between men and women. The collected data were analyzed using SPSS, T-Test, Chi square and logistic regression and $p<0.05$ was considered significant.

Results

In this study, 1616 elderly people (60 years and above) were included in the study using census. Based on exclusion criteria, 134 people were excluded and 1482 people including 817 men (55.1%) and 665 women (44.9%) were included in the study. The mean age of participants was 69.0±7.3 years (an age range of 60 – 92 years). 1118 older people (75.4%) were below 75 years old and 364 elderly (24.6%) were above 75 years old. 273 people (18.4%) had anemia. In this study, most elderly were married (85.4%), illiterate (63.3%) and had normal MMSE (69.4%). 271 participants (18.3%) including 119 men and 152 women had a history of falls. 35.3% of these people experienced recurrent falls within the past 12 months (table 1). The mean age of the patients who experienced falls was 70.55±7.93 years, and the mean age of those who had no experience of falls was 68.73±7.10 years (p=0.001). This difference in men was also significant (p=0.000), whereas in women, although the age of those who experienced falls was higher, there was no significant relationship between age and falls. The mean hemoglobin in all the participants as well as men (13.46 and 13.84 g/dl, respectively) was less than people who did not experience falls (13.74 g/dl, p=0.009 and 14.33 g/dl, p=0.007, respectively). The women who experienced falls were significantly younger than women who did not experience falls (p=0.004). However, in regard with BMI, the difference was not significant in all people and men who experience falls, though they had lower BMI (p=0.213 and p=0.737, respectively) (table 2). In

logistic regression model, the relationship between variables and falls was analyzed. While 21.2% of those who had anemia experienced falls and 17.6% of those who did not have anemia experienced falls, this difference was not significant either in the raw model (p = 0.161) or the adjusted model (p=0.940), into which all variables were entered. In raw model, gender (p=0.000, OR=1.73), age (p=0.000, OR=1.8), balance score (p=0.001), underlying disease (p=0.002, OR=2.35), depression (p=0.000, OR=2.47), living alone (p=0.027, OR=1.67) and MMSE (p=0.006) were significantly related to falls. However, in the adjusted model, age (p=0.000, OR=1.81), underlying disease (p=0.000, OR=1.20) and depression (p=0.000, OR=1.84) were significantly related to falls (table 3). When this model was separately used for men by entering the same variables, age group, anemia and underlying diseases were most related to falls at the final model. In women, the variables of BMI, depression and concomitant diseases were left at the final stage (table 3).

Table 1. Frequency distribution and percentage of participants in the study according to demographic characteristics.

Study variables		Number (%)
Gender	Male	817(55.1)
	Female	665(44.9)
Living alone	Yes	102 (6.9)
	No	1380(93.1)
Marital status	Married	1265(85.4)
	Single	149 (10.1)
	Divorced	3 (0.2)
	Spouse passed away	65 (4.4)
Education level	Illiterate	938 (63.3)
	Primary and secondary	439 (29.6)
	High school and university	105 (7.1)
Smoking	Yes	276 (18.6)
	No	1206(81.4)
Falls within the past 12 months (1482 participants)	Yes	271 (18.3)
	No	1211(81.7)
Depression	Yes	633 (42.7)
	No	849 (57.3)
BMI (kg/m2)	25 <	488 (32.9)
	29.99 – 25	633 (42.7)
	30 ≥	361 (24.4)
Age (years)	75 ≤	1118(75.4)
	75 >	364 (24.6)
Diabetes mellitus	Yes	456 (30.8)
	No	1026(69.2)
High blood pressure	Yes	922 (62.2)
	No	560 (37.8)
BBT	0 – 20	7 (5)
	21 – 40	83 (5.6)
	41 – 56	1392(93.9)
MMSE	Normal	1028(69.4)
	Abnormal	454 (30.6)

Table 2. Comparison of the falls in terms of variables, based on gender

Variable	Woman (Mean ±2SD)			Men (Mean ±2SD)			Total (Mean ±2SD)		
	P	Without experience of falls	With experience of falls	P	Without experience of falls	With experience of falls	P	Without experience of falls	With experience of falls
Age (year)	0.087	68.09±6.80	69.18±7.01	0.000	69.19±7.26	72.29±8.70	0.001	68.73±7.10	70.55±(7.93
Average number of drugs	0.343	3.51 ±2.74	3.75±2.58	0.050	2.00±2.38	2.54±2.79	0.002	2.64±2.64	3.21±2.74
Number of underlying diseases	0.001	3.29±1.92	3.92±2.04	0.000	2.00±1.62	2.81±2.00	0.000	2.54±1.87	3.43±2.10
Mean hemoglobin g/dl	0.098	12.95±1.40	13.16±1.42	0.007	14.33±1.47	13.84±1.75	0.009	13.74±1.60	13.46±1.61
Mean hematocrit (%)	0.378	93.84±3.87	40.15±3.83	0.007	43.32±3.97	42.05±4.76	0.009	41.85±4.30	40.98±4.36
BBT	0.012	49.37±6.68	47.54±8.08	0.001	53.44±4.36	51.31±6.88	0.000	51.72±5.82	49.20±7.80
MMSE	0.076	24.35±3.72	23.72±4.24	0.061	26.42±2.76	25.74±3.76	0.001	25.54 (3.36)	24.61±4.16
BMI kg/ m2	0.004	28.85±4.84	27.60±4.54	0.737	26.42±2.76	25.94±3.68	0.213	27.25 (4.62)	26.87±4.26

Table 3. Comparison of the prevalence of falls based on variables in the logistic regression model

Variables		Without experience of falls N (%)	With experience of falls N (%)	crude OR (CI %95)	P-value	adjusted OR (CI %95)	P-value
Anemia	Yes	215 (78.8)	58 (21.2)	1.26 (0.91–1.74)	0.161	1.01(0.71–1.42)	0.940
	No	996 (82.4)	213 (17.6)				
Gender	Male	698 (85.4)	119 (14.6)	1.73 (1.33–2.26)	0.000	1.36 (0.95–1.95)	0.085
	Female	513 (77.1)	152 (22.9)				
Age	Below 75	940 (84.1)	178 (15.9)	1.81 (1.36–2.41)	0.000	1.81 (1.30–2.53)	0.000
	Above 75	271 (74.5)	93 (25.5)				
BMI(kg/m2)	Below 25	393 (80.5)	95 (19.5)	Unmeasurable	0.675	Source	0.368
	25 – 29.9	519 (82.0)	114 (18.0)			0.89 (0.64–1.23)	0.486
	Above 30	299 (82.8)	62 (17.2)			0.75 (0.50–1.11)	0.157
BBT	0 - 20	4 (57.1)	3 (42.9)	Unmeasurable	0.001	Source	
	40 -21	56 (67.5)	27 (32.5)			0.56 (0.11–2.86)	0.492
	41 - 56	1151 (82.7)	241 (17.3)			0.44 (0.09–2.10)	0.305
Diabetes	Yes	364 (79.8)	92 (20.2)	1.19 (0.90–1.58)	0.210	0.87 (0.64–1.19)	0.410
	No	847 (82.6)	179 (17.4)				
High blood pressure	Yes	747 (81.0)	175 (19.0)	1.13 (0.86–1.49)	0.375	0.86 (0.64–1.17)	0.351
	No	464 (82.9)	96 (17.1)				
Underlying disease	Yes	1064 (80.6)	256 (19.4)	2.35 (1.36–4.08)	0.002	1.20 (1.10–1.29)	0.000
	No	147 (90.7)	15 (9.3)				
Education level	Illiterate	754 (80.4)	184 (19.6)	Unmeasurable	0.162	Source	0.821
	Primary and secondary	366 (83.4)	73 (16.6)			0.95 (0.68–1.31)	0.762
	High school and university	91 (86.7)	14 (13.3)			1.16 (0.62–2.18)	0.635
Smoking	Yes	227 (82.2)	49 (17.8)	0.95 (0.68–1.34)	0.800	1.25 (0.83–1.89)	0.276
	No	984 (81.6)	222 (18.4)				
Depression	Yes	468 (73.9)	165 (26.1)	2.47 (1.88–3.23)	0.000	1.84 (1.36–2.49)	0.000
	No	743 (87.5)	106 (12.5)				
Living alone	Yes	75 (73.5)	27 (26.5)	1.67 (1.05–2.65)	0.027	1.10 (0.67–1.82)	0.693
	No	1136 (82.3)	244 (17.7)				
MMSE	Normal	861 (83.8)	167 (16.2)	Unmeasurable	0.006	1.01 (0.73–1.40)	0.911
	Mild	271 (77.4)	79 (22.6)				
	Moderate	76 (776)	22 (22.4)				
	Severe	3 (50.0)	3 (50.0)				

The mean hemoglobin was higher in men than in women (Figure 1). Men with higher level of hemoglobin experienced less falls, which was quite the opposite for women and those with higher level of hemoglobin experienced more falls (Figure 2).

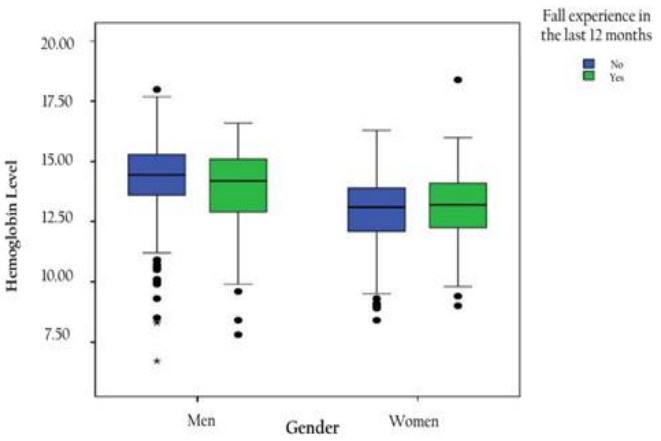

Figure 1. Comparison of the mean Hemoglobin in the Elderly and its relationship with falls.

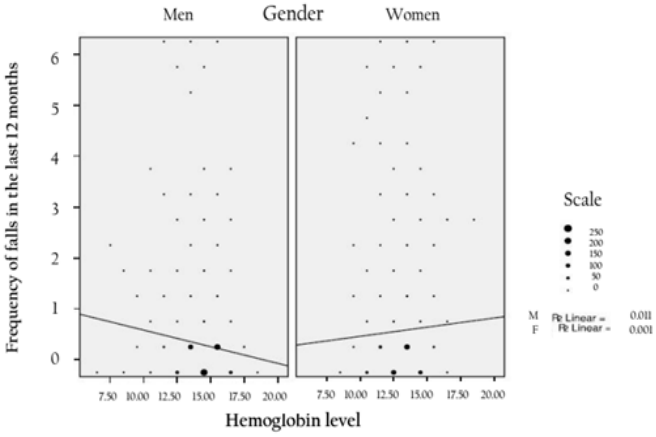

Figure 2. Distribution of the number of falls based on gender over the 12-month period

Discussion

Unlike most previous studies, anemia did not increase the risk of falls in this study, however, it increased the risk of falls in the elderly men. Moreover, the hemoglobin level in the elderly (regardless of gender) and elderly men was significantly lower in the group that experienced falls. In a study by Thaler-Kall et al. among 967 elderly people above 65 years old in general population, there was no significant relationship between anemia and falls, either in unadjusted model or the model modified with several variables. When patients were categorized based on age and gender, there was no significant relationship between anemia or hemoglobin level and falls. However, after general analysis of the sample after modifying several variables, the risk of falls in patients with simultaneous anemia and disability was significantly two times more than patients without anemia and disability (1).

In terms of investigation in the general population and the lack of association between anemia and falls, this study was consistent with the present study, however, in terms of lack of relationship between falls and hemoglobin was not consistent with our study. Moreover, the prevalence of anemia in people who experienced falls (21.2%) and those who did not experience falls (17%) in the study of Thaler-Kall is very close to our results (21.2 and 17.7%, respectively). Dharmarajan et al. in their study among the hospitalized elderly who were able to move, concluded that there is a significant relationship between anemia and falls, which is not consistent with our study. Moreover, the percentage of anemia in elderly who fell and the elderly who did not fall (56 and 38%, respectively) was much more than our study, probably indicating anemia due to chronic diseases in the hospitalized patients (16). The study of Reardon et al. among 632 residents of care centers for the elderly, in which the definition of anemia and frequent falls was similar to our study, concluded that the prevalence of falls in the elderly who have anemia and who use nerve stimulant drugs was significantly higher. Lower balance score, age 75 years and above, chronic kidney disease and nerve stimulant drugs significantly increased the risk of falls (19). The study population in these two studies, with about 40 - 50% of the elderly having anemia, was different from our study (18.4% of the elderly in our study had anemia), which was the cause of this statistical difference.

Bowling et al. demonstrated that there is a linear relationship between hemoglobin decline and falls in men, which is consistent with our study, whereas in regard with women, the diagram of the level of hemoglobin and falls has a U shape; that is, women who have low hemoglobin level experience more falls. However, the possibility of more falls in women with

higher hemoglobin disappeared after the smoking variable was adjusted. The relationship between hemoglobin level and fall in women is linear in our study, however, the increasing hemoglobin levels increased the rate of falls and this relationship remained after adjusting all variable. It is worth mentioning that people older than 45 years were defined as the elderly in the study of Bowling et al. (11), whereas people older than 60 years were defined as the elderly in our study.

In the study of Penninx et al., of 394 elderly people, 11.9% (18 women and 29 men) had anemia. However, despite the small sample size, the frequent falls in the people with anemia was 1.9 times more than other people (CI-95% =3.36-1.09), which is not consistent with the present study (14). In the study of Pandya et al., 564 residents of care centers for the elderly were included in the study, 70% of which were women. The mean age was 81±12.3 years and 56% of them had anemia. In regression model for all factors involved in the falls, anemia (p=2.26, p=0.001), nerve stimulant drugs and age above 85 led to more than twice more risk (12).

In addition to the differences in the studied population, the mean age of the elderly and gender relativity is different from the present study. Although depression, high blood pressure and diabetes were among the underlying diseases, in this study we preferred to differentiate them from other concomitant diseases. Of all variables, depression increased the risk of falls in the elderly by 1.84 times, which was the strongest factor. In some studies mentioned before, the effect of nerve stimulant drugs on falls was assessed, while depression was not assessed as an independent variable. Diabetes and blood pressure alone did not increase the risk of falls, but the sum of other concomitant diseases increased the risk of falls by 1.2 times. Perhaps it would be better if the association between chronic diseases and falls was measured separately. On the other hand, one of the major causes of anemia is chronic diseases. Considering that anemia is one of the manifestations of severe disease, the association between hemoglobin decline and falls may be due to the severity of the disease, not the hemoglobin itself. The advantages of the present study include the gender differentiation in all variables and analyzing BMI variable, which has been less studied in previous researches.

Maybe BMI limits mobility and increases chance of falls, or maybe lower weight is a sign that the patient is sicker and more likely to fall. Currently, studies show that falls and its damages in the elderly is associated with social problems, negative effects on their quality of life and their survival rates (20, 27). Determining the cause of falls is very helpful to prevent falls (28). Some of these factors are modifiable such as vision problems (10). Other factors, such as environmental factors, can be modified to a very limited extent. If the cause of the fall was also asked in this study, better results would be obtained. The response to falls was self-reported, and this is important because perhaps the individuals do not remember the incident or deny falls on purpose to conceal their disability and this certainly affects the result. In this study, we found no significant relationship between anemia and falls in the elderly. However, after differentiating gender, there was a significant association between anemia and hemoglobin decline with falls in men, while in women, increased hemoglobin level was followed by increase in falls. Further studies are required to analyze the association between increased hemoglobin level and falls in women. Age over 75 years, depression and underlying diseases increase the risk of falls. Given that our study was an observational study, not interventional, a study on the relationship between falls and anemia, before and after anemia treatment, is advised.

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