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Prevalence and Impact of Anemia Among Elderly Population in Qatar: A Cross Sectional Study

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Abstract

Background: Anemia is a most common condition in the older population, and the prevalence of anemia increases with advanced age. The present study is conducted to estimate the prevalence of anemia in elderly population and to identify the potential predictive factors associated with the etiology and disease progression.

Methods: A retrospective chart review was conducted to include all geriatric patients (≥60 years) with anemia admitted at the geriatrics facilities (Rumailah hospital, skilled nursing facility and home healthcare services) in the state of Qatar between January 2013 and December 2013. Data include demographics, principle diagnosis, laboratory findings hemoglobin, hematocrit value, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), reticulocyte count, iron profile, serum folate, serum Creatinine other co-morbidities, medication, and assessment. Charlson's comorbidity index, activity of daily living (ADL) and Bergs Balance Scoring level was compared with severity of anemia. Analysis was also performed for gender based on different age groups.

Results: Prevalence of anemia was analysed according to severity. A total of 522 elderly patients were found to be anemic with mean age of 78.2 ± 8.6 years; of which 66.7% were females. The majority of patients were Qatari nationals (79.7%).

The mean index hemoglobin level was 11.04 ± 1.6 and lowest hemoglobin level was 9.7 g/dl ± 1.6 g/dl. The severity of anemia was classified as mild deficiency (17.4%),

moderate (60.3%) and severe anemia (21.8%). The severity in the hemogram values among patients showed significant difference for hematocrit (p=0.001), serum Iron (p=0.001) and serum Ferritin (p=0.001). Co-morbidities such as chronic kidney disease (p=0.001), and Gastrointestinal bleeding (p=0.03) were also were higher in severe group. There was significant negative correlation between hemoglobin level and creatinine level (p=0.001) among elderly patients. Patients with severe anemia were more likely to receive clopidogril (p=0.01), H2 blocker (p=0.04) and calcium (p=0.01). Severe anemia was observed more in patients with advanced age (≥ 80 years) while, elderly <80 years suffered frequently with mild-to-moderate anemia. The common type of anemia was diagnosed as normocytic normochromic anemia (73.6%) than microcytic anemia (26.8%).

Conclusion: The present study identified a high prevalence of anemia among geriatric population in Qatar, with a higher frequency of comorbidities such as diabetes mellitus, hypertension and chronic kidney disease. An appropriate clinical approach is essential to treat anemia in elderly that can improve the quality of life and minimize the needs and costs of long-term healthcare facilities.

Keywords: Anemia; Elderly; Prevalence; Comorbidities

Introduction

Anemia is a common concern in geriatric health, but its exact incidence and prevalence remains known in many parts of the world. Anemia is more common among older persons and the prevalence increases with advancing age [1] In United States, 10.2% of women aged 65 and older are anemic [2]. It is an important public health issue and is commonly observed worldwide. Anemia in older adults is frequently associated with negative outcomes, including decreased physical performance, increased number of falls, increased frailty, increased hospitalization, increased cognitive impairment and increased mortality [3]. Moreover, the presence of anemia is associated with a worse prognosis for both morbidity and mortality. Iron deficiency anemia and secondary anemia are relatively frequent. Patients with iron deficiency anemia should be examined for the presence of gastrointestinal disease, including malignant disease, as a possible underlying condition. In addition, secondary anemia may result from chronic infectious disease, chronic inflammatory disease such as collagen disease, chronic renal failure, and endocrine disease. To date, there are no published studies in the elderly population from

the Arab Middle Eastern region. Herein, we report the prevalence of anemia and its effects on elderly population in Qatar.

Methods

Study settings

All patients in geriatrics facilities including Rumailah hospital, skilled nursing facility and home healthcare services in Qatar. Patients who underwent baseline hemogram profile on study period were included for the study in the period January 2013 to December 2013. The electronic medical record and physician's notes of individuals were used to identify patients with anemia predominantly aged 60 years and over living in Qatar, together with WHO criteria used to define anemia.

Measures

our inclusion criteria are geriatric patients (both men and women) aged above 60 years with confirmed anemia, had ≥one hemoglobin (Hb) level (Hb<12 g/dL in women and <13 g/dL in men) reported during the data uptake period were considered for analysis.

Patients with known hematologic malignancy, or cancer chemotherapy or radiation therapy completed within 6 months, age less than 60 years, no blood investigations, evidence of active bleeding (e.g. melena, haematochezia, haematuria, haematemesis, bleeding peptic ulcers, bleeding colonic carcinomas) were excluded from the study. Medical records were reviewed, and relevant data were abstracted which includes demographics (age, gender, nationality), date of admission; admission hemoglobin, hematocrit, and mean corpuscular volume (MCV), lowest hemoglobin, hematocrit, and MCV, medications including therapies for anemia, activities of daily living (ADL), comorbidities and information on anemia work-up and falls.

Definitions of anemia and causes

The earliest Hb level obtained during the uptake period was identified as the index Hb Level [4]. The patient's clinical parameters, management and any incidents of falls were then followed through the chart for the study period following the index date. The present study uses the World Health Organization (WHO) definition of anemia was as hemoglobin level less than 13 g/dL in men and less than 12 g/dL in women. On the basis of hemoglobin levels, patients were categorized as having mild anemia (male patients, 12 g/dl to 12.9 g/dL and female patients, 11 g/dl to 11.9 g/dL), moderate anemia (male patients, 9 g/dl to 11.9 g/dL and female patients, 8-10.9) and severe anemia (male patients, less than 9 g/dL and female patients, less than 8 g/dL) [5]. Patients were categorized as anemic or non-anemic using the lowest recorded hemoglobin value. MCV values below 80 were classified as microcytic, values between 80 and 100 were classified as normocytic, and values greater than 100 were classified as macrocytic. Iron deficiency anemia was considered present if the elderly had low serum iron (lower than 50 μg/dL in women and 60 μg/dL in men), low ferritin (lower than 15 ng/mL), low transferrin saturation rate (lower than 16%) or increased total iron binding capacity (higher than 450 μg/dL). Anemia of chronic disease was defined as low circulating iron in the presence of increased iron stores (normal or increased ferritin higher than 100 ng/mL, transferrin saturation higher than 25% and lower than 50%) and decreased total iron binding capacity (lower than 250 μg/dL). Anemia associated with folate or vitamin B12 deficiency

was defined as concentrations of folate lower than 3.0 ng/mL or vitamin B12 lower than 200 pg/mL and MCV higher than 95 fL. Subjects were classified as having anemia related to chronic renal disease when affected by renal insufficiency. Anaemia of chronic renal disease was defined as an estimated creatinine clearance less than 30 ml/min [6]. Anaemia of chronic inflammation (ACI) was defined as low serum iron count (less than 11 μmol/l) without evidence of iron deficiency. Anemia where no work-up was pseudo-anemias that could not be classified into any of the previous categories were considered to be of unexplained origin. The disease burden was quantified with the Charlson's co-morbidity index. A fall was defined as the sudden, unintentional loss of posture causing an individual to inadvertently rest at a lower level, without use of overwhelming external force. It measured by performance on seven ADL items (bed mobility, transfer, locomotion, dressing, eating, toilet use and personal hygiene) are each reported in the MDS on a scale from 0 (independent) to 4 (total dependence). The sum of the seven ratings yields a 0- to 28-point ADL score, where a higher score indicates lower ADL performance (greater dependence). This method was also applied to the 'Test for Balance' reported in the MDS. The two balance items (balance while standing, balance while sitting) are scaled from 0 (maintained position as required in test) to 3 (not able to attempt test without physical help). The sum of the two ratings yields a 0- to6-point score, where a higher score indicates lower balance performance.

Laboratory variables

Haemoglobin concentration was determined using the Coulter LH 750, Advia 2120/120 or Sysmex XE 5000/2100 cell counter. Serum iron and total iron-binding capacity was measured by spectrometry on Beckman Coulter DXC 800 (Beckman Coulter Unicel DXC systems). Serum ferritin was determined on Beckman Coulter DXI by chemiluminescent immunoassay (Beckman Coulter ACCESS immunoassay systems). Transferrin saturation was calculated by dividing serum iron by total iron-binding capacity. Folate and vitamin B12 was measured by Beckman Coulter DXI chemiluminescent immunoassay (Beckman Coulter ACCESS immunoassay systems).

Serum creatinine was measured by kinetic colorimetric (Jaffe method) on Roche Modular DP and Cobas 6000 analyser (Roche Diagnostics) or kinetic colorimetric (Jaffe method) on Beckman Coulter DXC 800 (Beckman Coulter Unicel DXC systems).

For assessing renal function, we used the formula for estimating glomerular filtration rate (GFR) according to recently updated Swedish guidelines [7]. The major disease categories were classified as follows: cardiac: coronary artery disease (CAD), congestive heart failure (CHF); diabetes; hypertension; musculoskeletal disease: arthritis, myopathy, bone disease fracture; neurological: dementia, delirium, cerebrovascular disease, neuropathy; pulmonary disease: chronic obstructive pulmonary disease (COPD), connective tissue disease and renal insufficiency or failure (chronic kidney disease (CKD) creatinine more than 1.5).

The study has been ethically approved with a waiver of informed consent by the institutional medical research center (IRB #14068/14).

Statistical analysis

Descriptive analysis was performed to summarize all demographics and clinical characteristics of the participants. Data were presented as proportions or mean ± standard deviation (SD) or median and range, as appropriate. Patients were divided into two groups as Mild/

moderate anemia versus severe anemia. Differences in categorical variables were analyzed using the chi-square test and the continuous variables were analyzed using unpaired Student-t test. For small cell frequencies, chi-square test with continuity correction factor was used. For skewed continuous data, non-parametric Mann-Whitney test was performed. Correlation between Body Mass Index (BMI) and lowest hemoglobin levels and albumin levels, lowest hemoglobin levels and albumin was analyzed using Pearson correlation coefficient. A two-sided P value of 0.05 was considered to be statistically significant. All Statistical analyses was done using statistical packages SPSS 19.0 (SPSS, Inc., Chicago, IL USA).

Results

The overall prevalence of anemia in our study cohort is 522 total number of admission during the study period). A total of 522 elderly patients were found to be anemic with mean age of 78.2 ± 8.6 years; of which 66.7% were females. The majority of patients were Qatari nationals (79.7%). The mean index hemoglobin concentration in elderly was 11.04 g/dl ± 1.6 g/dL and lowest hemoglobin concentrations were 9.7 g/dl ±1.6 g/dL (Table 1). The severity of anemia was classified as mild deficiency (17.4%), moderate (60.3%) and severe anemia (21.8%). The severity in the hemogram values among patients showed significant difference for hematocrit (p=0.001), serum Iron (p=0.001) and serum Ferritin (p=0.001). Majority of elderly males and females suffered from moderate anemia (60.9% vs. 61%) while, severe anemia was significantly higher in males (31.6% vs. 17%, p=0.001) (Figures 1 and 2). The common type of anemia was diagnosed as normocytic normochromic anemia (72.7%) than microcytic anemia (26.8%). Anemia prevalence increased with age, it was higher in females (40.6%) than males (28.7%) till the age of 80 years and was higher in men (46.5%) than women (32.4%) in advanced age above 80 years (Figure 3), and also was higher in Qataris people (77.6%) than non-Qatari residents (22.4%). Most individuals classified as anemic using WHO criteria were only moderately anemic. There is marked positive linear correlation between severity of anemia and low albumin levels (r=0.335, P=0.001) indicating that albumin might be a predictor of inflammatory process of acute or chronic disease which may lead to anemia in elderly (Figure 4).

Age (mean ± SD)	78.2 ± 8.6	Pulmonary disease	
≤69 years	84 (17.4%)	Connective tissue disease	1 (0.2%)
70-79 years	176 (36.5%)	COPD	37 (7.1%)
80-89 years	180 (37.3%)	**Other Co-morbidities**	
≥90 years	42 (8.7%)	Chronic Kidney disease	139 (26.6%)
Female	348 (66.7%)	Peptic ulcer disease	1 (0.2%)
Nationality		Blood transfusion	11 (2.1%)
Qatari	415 (79.7%)	Recent surgery within 3 mon	0 (0%)
Non-Qatari	106 (20.3%)	Falls	13 (2.5%)
Marital Status		Fracture	34 (6.5%)
Married	385 (85.4%)	Liver disease	11 (2.1%)
Single	6 (1.3%)	AIDS	0 (0%)
Widow	52 (11.5%)	Hemiplegia	14 (2.7%)
Urinary Tract Infection	12 (2.3%)	**Medication**	
Infected bed sore	5 (1.0%)	Aspirin	267 (51.1%)
Dementia	22 (4.2%)	Clopidogril	114 (21.8%)
Social admission	1 (0.2%)	Iron therapy	183 (35.1%)
Cerebrovascular accident	61 (11.7%)	Vitamin C	39 (7.5%)
Others	102 (19.5%)	Proton Pump Inhibitor	318 (60.9%)
Charlson Comorbidity Index		H2 blocker	37 (7.1%)
Cardiovascular		Calcium	104 (19.9%)
Myocardial Infarction	23 (4.4%)	**Assessment**	
Coronary Artery Disease	121 (23.2%)	Height	156.0 ± 12.5
Congestive Heart Failure	53 (10.2%)	Weight	69.4 ± 25.6

Polyvascular disease	24 (4.6%)	Body Mass Index	28.2 ± 9.3
Diabetes Mellitus	364 (69.7%)	**Type of feeding**	
Hypertension	446 (85.4%)	Oral	302 (70.6%)
Musculoskeletal		Nasogastric tube	80 (18.7%)
Osteoarthritis	69 (13.2%)	Percutaneous	14 (3.3%)
		endoscopic gastrostomy	
Osteoporesis	20 (3.8%)	Naso-jejunal tube	32 (7.5%)
Myopathy	1 (0.2%)		
Neurological			
Dementia	106 (20.3%)		
Cerebrovascular accident	169 (32.4%)		
Berg Balance score (n=293)		Serum Iron (umol/L) (Ref: 5.4-28.6)	8.4 ± 4.8
Independent (41-56)	11 (3.8%)	Low serum iron (≤5.3 umol/L)	88 (29.5%)
Walking with assistance (21-40)	23 (7.8%)	Serum Ferritin (ug/L) (Ref: 11-304)	120 (2-1969)
Wheelchair bound (0-20)	259 (88.4%)	Low ferritin (<11 ug/L)	13 (5.9%)
Activities of Daily Living Score (n=307)		Folate (g/l)	26.1 (2-1302)
0- independent	182 (59.3%)	Serum creatinine (umol/L) (Ref: 53-97)	81.5 (23-1220)
1- supervision	1 (0.2%)	Albumin	34.6 ± 5.8
2- limited assistance	50 (9.6%)	Lowest hemoglobin (g/dl)	9.7 ± 1.6
3- extensive assistance	2 (0.4%)	Hemoglobin category	
4- total dependence	72 (23.5%)	Mild deficiency	93 (17.4%)
Laboratory findings		Moderate	315 (60.3%)
Index hemoglobin (g/dl)	11.04 ± 1.6	Severe	114 (21.8%)
Mean corpuscular volume (fl) (Ref: 83-101)	84.1 ± 9.3	Red Blood Cells (×10^6/ul) (Ref: 3.8-4.8)	4.0 ± 2.5
Microcystic (<80)	139 (26.8%)	Total iron binding capacity (umol/L) (Ref: 45-80)	45.6 ± 14.4
Normocystic (80-100)	377 (72.6%)	Decreased TIBC (<45 umol/L)	126 (50.4%)
Macrocystic (>100)	3 (0.6%)	Transferrin saturation (%)	16.7 (1.7-224)
Mean corpuscular hemoglobin (pg) (Ref: 27-32)	26.9 ± 3.3	Low Transferrin saturation (<16%)	78 (49.1%)
Reticulocyte count	59.7 ± 44.4	Vitamin B12 (pmol/l)	495 ± 377
Hematocrit (%) (Ref: 36-46)	33.3 ± 15.2	Glomerular filtration rate (ml/min/1)	65 (4-266)
		Blood urea nitrogen (mmol/l)	7.5 (1.4-277)

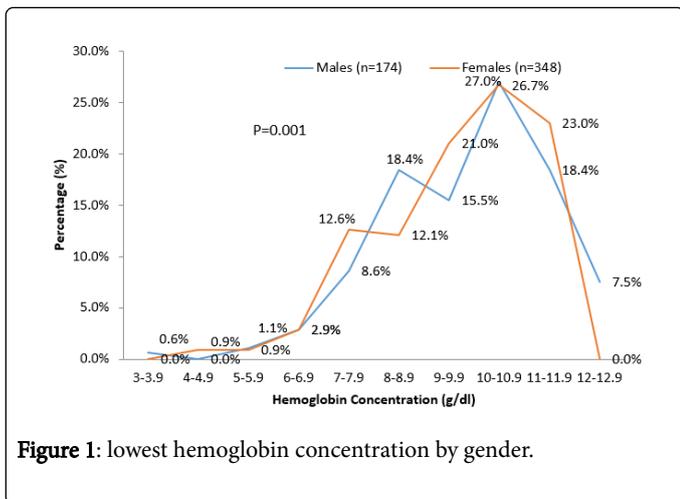**Table 1:** Prevalence of anemia among elderly patients (n=522).

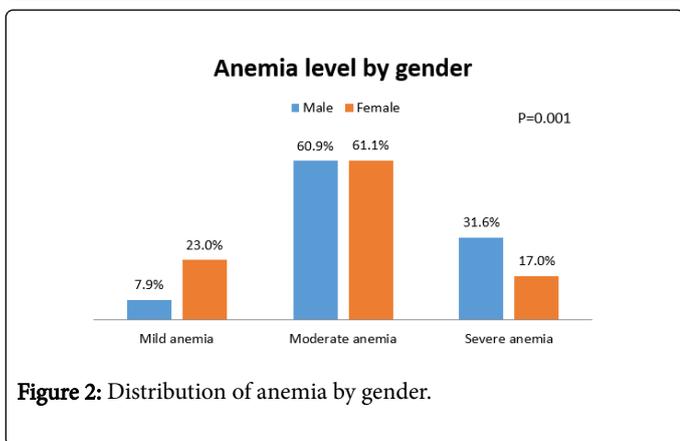**Figure 1:** lowest hemoglobin concentration by gender.

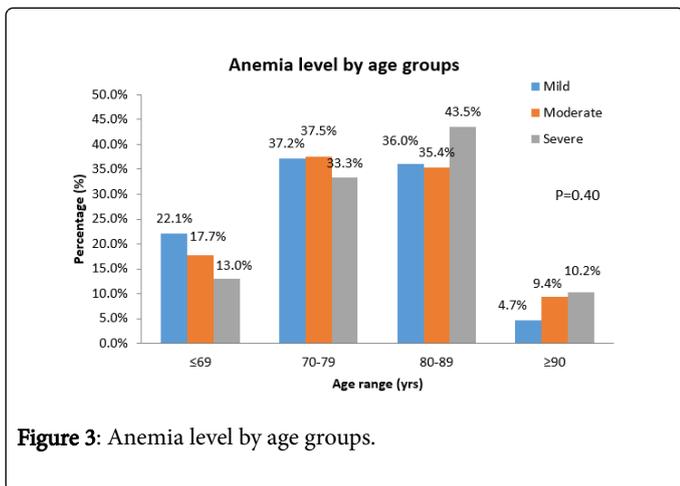**Figure 2:** Distribution of anemia by gender.

Figure 3: Anemia level by age groups.

Discussion

In the past, anemia in the elderly has been considered a part of the normal physiologic process [8]. At the recent time, however, anemia in the elderly is considered a type of pathologic condition caused by chronic diseases [9]. This unique study was conducted to estimate the prevalence of anemia in elderly patient in Qatar.
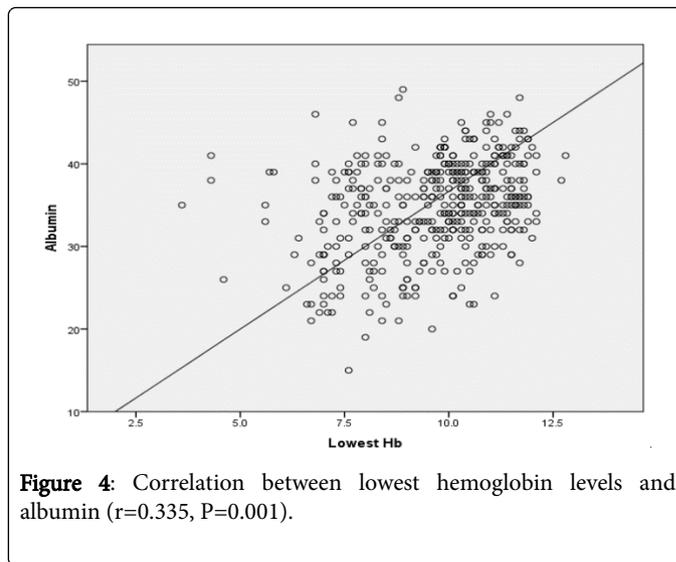

Figure 4: Correlation between lowest hemoglobin levels and albumin (r=0.335, P=0.001).

There was significant negative correlation between hemoglobin level and creatinine level (r=-0.209, p=0.001) among elderly patients (Figure 5). There observed no association between dementia and lowest hemoglobin levels (9.7 ± 1.5 vs. 9.2 ± 1.9, p=0.14) (Figure 6). Also, there is no association of dementia status by anemia levels (p=0.76, Figure 7). Table 2 compares the demographics and co-morbidities among the elderly patients by type of anemia. Co-morbidities such as chronic kidney disease (p=0.001), and Gastrointestinal bleeding (p=0.03) were also were higher in severe group. Severe anemia was observed more in patients with advanced age (≥ 80 years) while, elderly <80 years suffered frequently with mild-to-moderate anemia. Patients with severe anemia were more likely to receive clopidogril (p=0.01), H2 blocker (p=0.04) and calcium (p=0.01) (Table 3).
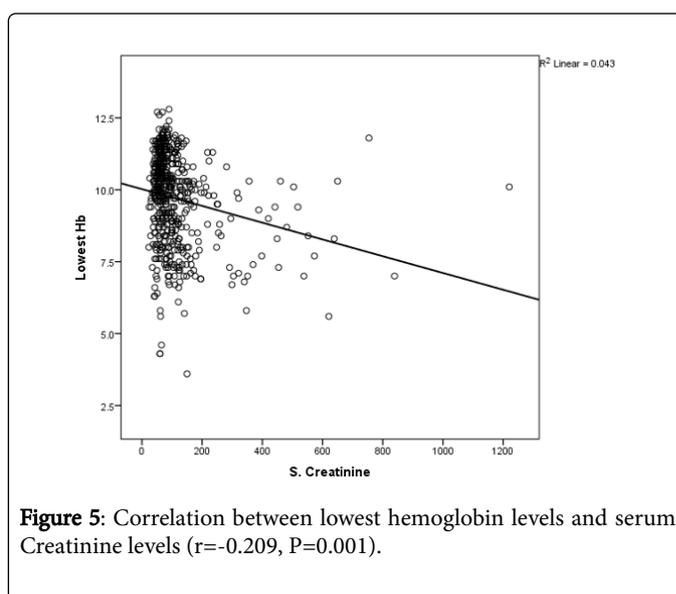

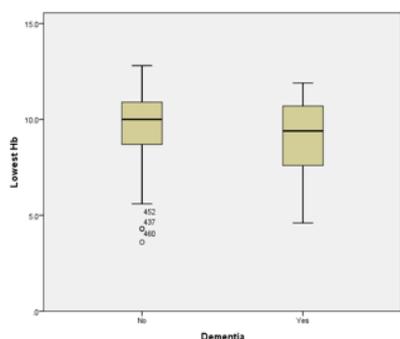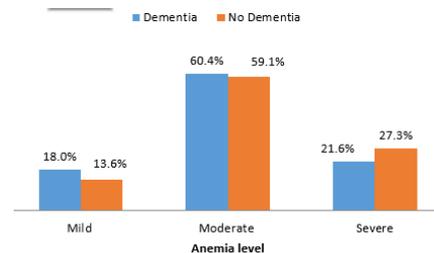**Figure 5:** Correlation between lowest hemoglobin levels and serum Creatinine levels (r=-0.209, P=0.001).

Figure 6: Association between dementia and lowest hemoglobin levels (9.7 ± 1.5 vs. 9.2 ± 1.9, p=0.14).

Figure 7: Dementia status by anemia levels (p=0.76).

Variables	Mild/moderate Anemia (n=408) Men: 9-12.9 g/dL Women: 8-11.9 g/dL	Severe Anemia (n=114) Men: <9 g/dL Women: <8 g/dL	P-value[*]
Age (mean ± SD)	77.8 ± 8.7	79.3 ± 8.1	0.09
Gender (%)			
Male	29.2	48.2	0.001 for all
Female	70.8	51.8	
Nationality (%)			
Qatari	79.6	79.8	0.95 for all
Non-Qatari	20.4	20.2	
Marital Status (%)			
Married	84.9	86.9	0.90 for all
Single	1.4	1	
Widow	11.6	11.1	
Divorced	2	1	
Principle diagnosis (%)			
Aspiration Pneumonia	5.1	6.1	0.67
Urinary Tract Infection	2.2	2.6	0.78
Infected bed sore	0.7	1.8	0.32
Dementia	3.9	5.3	0.52
Social admission	0	0.9	0.05
Cerebrovascular accident	10.3	16.7	0.06
Others	17.9	25.4	0.07
Charlson Comorbidity Index			
Cardiovascular (%)			

Myocardial Infarction	4.4	4.4	0.91
Coronary Artery Disease	21.3	29.8	0.05
Congestive Heart Failure	9.6	12.3	0.39
Polyvascular disease	3.7	7.9	0.05
Diabetes Mellitus	70.1	68.4	0.73
Hypertension	84.6	88.6	0.28
Musculoskeletal (%)			
Osteoarthritis	13.7	11.4	0.51
Osteoporesis	3.4	5.3	0.36
Myopathy	0.2	0	0.59
Neurological (%)			
Dementia	20.8	18.4	0.57
Cerebrovascular accident	30.6	38.6	0.1
COPD	6.9	7.9	0.7
Other Co-morbidities (%)			
Chronic Kidney disease	23	39.5	0.001
Peptic ulcer disease	0	0.9	0.05
Blood transfusion	0.2	8.8	0.001
Falls	2.2	3.5	0.43
Fracture	5.4	10.5	0.05
Liver disease	2	2.6	0.65
Hemiplegia	3.2	0.9	0.17
Type of feeding			
Oral	72.9	63	0.25 for all
Nasogastric tube	16.8	25	
Percutaneous	3	4	
endoscopic gastrostomy			
Naso-jejunal tube	7.3	8	
Berg Balance score			
Independent (41-56)	4.1	2.7	0.58 for all
Walking with assistance (21-40)	8.6	5.5	
Wheelchair bound (0-20)	87.3	91.8	
Mean corpuscular volume			
Microcystic (<80)	25.6	31	0.36 for all
Normocystic (80-100)	73.6	69	
Macrocystic (>100)	0.7	0	

Mean corpuscular hemoglobin	28.7±9.3	26.0±8.9	0.44
Hematocrit	34.8±16.7	27.9±5.3	0.001
Serum Iron	8.9±4.5	6.9±5.3	0.001
Low serum Iron	22.6	46.5	0.001
Serum Ferritin	112 (2-1580)	218 (4-1969)	0.001
Low serum ferritin	4.3	8.8	0.18
Folate	25.5 (2.0-1302)	26.9 (4.3-45.3)	0.96
Serum creatinine	77 (23-1220)	109 (35-839)	0.001
*p value <0.05: Statistically significant; COPD: chronic obstructive pulmonary disease			

Table 2: Demographics and co-morbidities among the elderly patients by type of anemia.

Variables	Mild/moderate Anemia (n=408) Men: 9-12.9 g/dL Women: 8-11.9 g/dL	Severe Anemia (n=114) Men: <9 g/dL Women: < 8 g/dL	P-value*
Medication			
Aspirin (%)	50.2	54.4	0.43
Clopidogril (%)	19.4	30.7	0.01
Iron therapy (%)	32.1	45.6	0.008
Vitamin C (%)	6.4	14.4	0.07
Proton Pump Inhibitor (%)	59.3	66.7	0.15
H2 blocker (%)	5.9	11.4	0.04
Calcium (%)	22.3	11.4	0.01

Table 3: Medications prescribed among the elderly patients by type of anemia.

There was a pronounced increase in the prevalence of anemia with increasing age within the older population; in the age group 85 years and older, one fifth of women and one fourth of men were anemic, consistent with findings in other studies [10]. Other significant independent determinants of anemia were diabetes, hypertension and kidney disease. These results reflect that certain underlying chronic diseases are likely to explain a large part of the anemia prevalence. Previous studies indicate that, in addition to underlying disease, malnutrition and iron, folate, and vitamin B12 deficiencies alone or in combination may explain another 20% to 30% of the anemia cases. However, in about 16% to 35% of cases, it is not possible to attribute anemia to underlying factors [11]. The present study shown that 46.8% subjects were mild anemic, 39.2% were moderate anemic and also 3.5% were found to have severe anemia; whereas 10.47% subjects had normal Hemoglobin level. According to WHO if the prevalence of anemia at community levels is more than 40%, it is considered as problem of high magnitude [12]. The normocytic anemia was the most common type of anemia. The other important findings were female sex, older age, low levels of albumin, low BMI, and higher creatinine level were identified as predisposing factors of anemia. It should be noted that the factors above, with the exception of female sex are all

associated with chronic illness and comorbid conditions. The strong association between hypo albuminemia and anemia suggests underlying chronic disease [9], and the low BMI may also be associated with anemia for the same reason. A higher creatinine level was associated with anemia due to a reduction in the circulating erythropoietin level [13]. A lot of patients were taking proton pump inhibitors had a history of anemia which might indicate the necessity for farther studies on the effect of medications and anemia in elderly.

From this study, we found that the most common type in elderly population in Qatar is normochromic normocytic anemia which is anemia of chronic disease which is mainly patients with chronic kidney disease. Moderate and severe types of anemia are more common in the age groups 70-98 years. 50% of the elderly were having low level of function and wheel chair bound in oral feeding which might indicate the cause of anemia for those patients is due to poor oral intake.

Study limitations

Some of the limitations of this study is that we involved hospitalized geriatric patients from home health care with multiple comorbidities

and are unhealthy. We need to include patients from the community, so it will be more representative of the population. The majority of the sample was females 66% compared to males, also it was difficult to measure rates for hospitalization in many of the patients. The other limitations include retrospective design and limited follow-up, potential for biased selection of relevant covariates, gaps in time between index Hb levels and falling events, non-random selection of various facilities, limits to quality and detail in data extracted from patient's medical charts, and confounding of anemia therapy with index hemoglobin level.

In conclusion, the present study identified a high prevalence of anemia among geriatric population in Qatar, with a higher frequency of comorbidities such as diabetes mellitus, hypertension and chronic kidney disease. An appropriate clinical approach is essential to treat anemia in elderly that can improve the quality of life and minimize the needs and costs of long-term healthcare facilities. Anemia still remains under-reported and inadequately investigated, particularly the mild form. It might be recommended to evaluate cases with even mild anemia. Longitudinal studies would be helpful in looking into the possible effects of therapeutic interventions among geriatric patients with anemia.

Acknowledgement

Author contribution

MO: study design, data collection and manuscript drafting; NN: data collection and manuscript drafting; HA: study design, data analysis and manuscript review; ES: data collection and manuscript drafting; MA: data collection and manuscript drafting; FN: study design and manuscript drafting.

References

1. Callera F, Callera AF, Da Silva AM, Rosa ES (2015) Prevalence of anemia in a sample of elderly southeastern Brazilians. Rev Bras Hematol Hemoter 37: 43–47.

2. Guralnik JM, Eisenstaedt RS, Ferrucci L, Klein HG, Woodman RC (2004) Prevalence of anemia in persons 65 years and older in the United States: evidence for a high rate of unexplained anemia. Blood 104: 2263-2268.

3. Pang WW, Schrier SL (2012) Anemia in the elderly. Curr Opin Hematol 19: 133–140.

4. Pandya N, Bookhart B, Mody SH, Funk Orsini PA, Reardon G (2008) 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 24: 2139-2149.

5. http://apps.who.int/iris/bitstream/10665/40707/1/WHO_TRS_405.pdf

6. Rambod M, Kovesdy CP, Kalantar-Zadeh K (2008) Combined high serum ferritin and low iron saturation in hemodialysis patients: The role of inflammation. Clin J Am Soc Nephrol 3: 1691-1701.

7. http://www.inahta.org/members/sbu/

8. Lipschitz DA, Mitchell CO, Thompson C (1981) The anemia of senescence. Am J Hematol 11: 47–54.

9. Salive ME, Cornoni-Huntley J, Guralnik JM, Phillips CL, Wallace RB, et al. (1992) Anemia and hemoglobin levels in older persons: Relationship with age, gender, and health status. J Am Geriatr Soc 40: 489-496.

10. Inelmen EM, DAlessio M, Gatto MR, Baggio MB, Jimenez G, et al. (1994) Descriptive analysis of the prevalence of anemia in a randomly selected sample of elderly people living at home: Some results of an Italian multicentric study. Aging (Milano) 6: 81-89.

11. Joosten E, Pelemans W, Hiele M, Noyen J, Verhaeghe R, et al. (1992) Prevalence and causes of anaemia in a geriatric hospitalized population. Gerontology 38: 111–117.

12. Seshadri S (1999) A database on iron deficiency anaemia (IDA) in India: prevalence, causes, consequences and strategies for prevention. Department of Foods and Nutrition. WHO Collaborating Centre for Nutrition Research. The Maharaja Sayajirao University of Baroda, Vadodara, India, 1999

13. Fehr T, Ammann P, Garzoni D, Korte W, Fierz W, et al. (2004) Interpretation of erythropoietin levels in patients with various degrees of renal insufficiency and anemia. Kidney Int 66: 1206-1211.