Infrequent consumption of Laban is associated with anemia in adults aged >50 years in Saudi Arabia

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Abstract

Introduction: Limited information is available on the prevalence of anemia in adults and elderly. Contradictory results are available regarding the association between drinking Laban and anemia in children and adults. No study has explored this association in the adults/elderly population. The aim of this study was to measure the prevalence and association between anemia and food items among adults aged >50 years in Riyadh, Saudi Arabia. Material & Methods: 266 Saudi adults aged >50 years were invited to participate in a cross-sectional study in Riyadh. Anthropometric measurements were taken and blood samples were collected. Blood hemoglobin was measured with a Coulter Cellular Analysis System using the light scattering method. Multiple logistic regression analyses were performed to identify the food items significantly associated with anemia. Results: The mean (±SD) hemoglobin was 13.8 (±1.6) mg/dL. Anemia was prevalent among 19.9% (n = 53) of the participants. Infrequent intake of red meat [adjusted Odds Ratio [ORa] 3.4; 95% confidence interval [CI] 1.2, 9.7] and Laban (fermented yogurt drink) [ORa 2.7, 95% CI 1.1, 6.7] were significantly associated with anemia, whereas obesity (BMI >30) was protective [aOR 0.4, 95% CI 0.2, 0.9] from anemia. Conclusion: Anemia is prevalent among Saudi males and females aged >50 years. The association between drinking Laban and anemia support the emerging evidence on the role of probiotics in preventing anemia among adults and elderly. It is recommended that people aged >50 years should get regularly screened for anemia.

Background

Anemia affects around 2.2 billion (33%) of people worldwide [1]. A systematic review estimated that 17% (ranging from 3 to 50%) of the adults aged >60 years from high income countries had anemia [2], whereas, in developing countries it is estimated to be as high as 45% [1]. Studies from Middle-East found that the prevalence of anemia in the elderly ranged between 6.3% to 16.3% [3, 4]. Alhamdan from Saudi Arabia reported the prevalence of anemia as 38% in adults (24 to < 60 years) and 55% in those aged > 60 years [5]. Few other studies found that the prevalence among Saudi adult males ranged between 2.3% to 6.3%, whereas in females it ranged between 18% to 21.0% [6- 7]. Anemia may lead to multiple negative health consequences, such as poor physical performance, decrease in body strength, increased risk of falls, exacerbation of associated disease conditions, impaired cognition and, in severe cases, even death [8 -10].

Anemia due to lack of appropriate and inadequate nutrition is considered as one of the most common types present among the older adults [11]. Nutritional anemia can be prevented by several food items, especially green vegetables, fruits, meat, liver, eggs are [12]. In majority cases, multiple factors act together and can lead to anemia in the elderly [12].

The world population ageing report, 1950 - 2050, reports a worldwide shift in the young-old age balance [13]. Similar to elsewhere in the world, Saudi Arabia is expected to observe an increase from 5.4% (1.6 million), to 25% in the population aged >50 years by 2050 [14]. Generally, it is believed that people aged >50 years will suffer from chronic diseases like hypertension, diabetes, or cardiovascular problems and anemia is not considered important [15]. A significant proportion of the population accepts it as a normal aging process being unaware of the long term consequences of anemia [15]. This study is part of a larger project on the prevalence and associated factors of anemia among different age groups in Riyadh, Saudi Arabia. Research publications (from the same project) focusing on children, adolescents and the child-bearing aged women have been published elsewhere The results related to middle-aged and elderly are being presented here. The objective of this study was to measure the prevalence and association between anemia and common food items among adults aged >50 years in Riyadh, Saudi Arabia.

Methods

Study participants

This study was part of a large community–based, two-staged household cross-sectional survey, and hence does not need to be registered. According to 2010 – 2011 census report, Riyadh has a total population of 3,151, 209 individuals [16]. In the first stage, one primary health care centers (PHCC) was randomly selected from each of the five administrative regions (East, West, North, South and Central) of Riyadh city. In the second stage, households situated in the catchment area of respective PHCC were approached and invited to participate. Assuming the prevalence of anemia at 50% in elderly and with 5% width of confidence interval, and significance level of 0.05, we needed to interview 368 women. For risk factors of anemia, assuming a type- I error of 0.05, type-II error of 0.20 (power of 0.80) and 30% difference of prevalence of risk factors in anemic and non-anemic participants, we need to have 300 adults aged > 50 years. However due to missing data and selection criteria, 266 participants were included in the final analysis. Figure 1 is showing the flow chart with number of participants included in the anemia project. The Institutional Ethical Review Board of King Saud University reviewed and approved the study protocol.

Data collection procedure and tools

Trained data collectors conducted the interviews to collection information about socio-demographic characteristics, medical history, smoking and reproductive history (from females only). Food frequency questionnaire inquired about the frequency of intake for red meat, vegetables, eggs, tea or coffee, fruit juices, beverages and laban (diluted yogurt) during the last one week. Medical history included past or current diseases such as peptic ulcer, hemorrhoids, parasitic infections, cancers and Bilharzias. Females were inquired about menopause and number of children. Anthropometric measurements included weight and height. Weight was measured in kilograms using an electronic scale (Secca 220 - Hamburg Germany 2009), whereas height was measured in cms using the stadiometer. The body mass index (BMI) was calculated by using the formula weight in kg / [height in m]^2 for each participant [17].

Collection and analysis of blood samples

A 5 ml sample of non-fasting venous blood was taken for hematologic examination, including: hemoglobin (Hb), red blood cell count, hematocrit and red cell indices; mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and red blood cell distribution width (RDW). The blood samples were collected in labeled and prepared tubes containing EDTA or heparin and stored at 4^0C in the refrigerator. All samples were analyzed in King Khalid hospital laboratory where hemoglobin estimation was performed by laboratory technicians using UniCell Dxlt 800, Coulter cellular analysis system (Beckman Coulter Inc. USA). The light scatter method was used to measure hemoglobin and red cell indices under the supervision of a hematologist. Quality control procedures (Coulter® 6C Cell Control) were followed as per the manufacturer's instructions.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences computer software package (IBM SPSS statistics version 21.0). The outcome variable (anemia) was defined according to the cut-off values recommended by World Health Organization (WHO) (males Hg <13 g/dl and females Hg <12 g/dl) [18]. Descriptive statistics with mean and standard deviations (SD) and percentages were calculated for continuous and categorical variables. Intake of dietary items was reported as frequently (5 – 7 days/week), infrequently (2 – 4 days/week) or 0 or 1 as never taken during the last week. The level of statistical significance was kept at $p < 0.05$. Pearson correlation coefficient was calculated to measure the correlation between continuous variables. Bivariate analysis was conducted to identify biologically plausible and statistically significant variables associated with anemia. Variables causing a change of 10% in the estimates were retained in the final model. Multivariable logistic regression was performed to identify important dietary items associated with anemia. Hosmer and Lemeshow goodness-of-fit test was used to assess the model-fit. Plausible interactions were checked before developing the final model.

Results

In total, 266 Saudi residents aged >50 years (186 males and 80 females) were included in the final analysis (Figure 1). The mean age of males and females was 57.7 (±10.2) and 55.4 (±5.2) years (ranging from 50 to 85 years) ($p = 0.08$), respectively. The overall prevalence of anemia was 19.9% (n =56), with no significant difference between males and the females [19.3% vs 21.2%, p= 0.7). The mean Hb (±SD) in males and females was 14.5 (±1.5) and 12.8 (±1.6) mg/dl respectively ($p < 0.01$). The blood indices in Table 1 are presenting the mean values for hemoglobin and the MCV, MCH, MCHC, and RDW. According to the WHO recommended hemoglobin cut-offs, majority (23%) were suffering from mild anemia (for males Hb 11.00 - 12.9 and females 11.00 - 11.9 g/dl) and only few had moderate anemia (Hb 8.0 - 10.9 g/dl) and severe (Hb <8.0 g/dl) [18].

Significant difference was observed between the mean age of anemic and normal participants in the females [56.7 (±3.1) vs 51.6 (±1.2, p =0.1] but not in the males [57.1 (±6.5) vs 60.0 (±5.8), p=0.08] respectively. The gender and age comparison found majority of anemic males were elderly (>60 years, n= 24 (67.7%), whereas higher percentage of anemic females (76.5%) belonged to age category <60 years (Figure 2). Majority of the participants were currently married and had education till primary level or less (Table 1). The mean reported number of children was five (±3) and ranged from 2 to 14. The mean (±SD) BMI of males and females was 29.0 (±5.2) and 31.2 (±6.4) [p = 0.004], respectively. No statistically significant difference was observed in mean BMI levels between anemic and normal Saudi males (p = 0.5) or females (p=0.4). A small percentage (ranging from 2% to 6%) of participants reported problems like peptic ulcers, hemorrhoids, cancers or Bilharzias diseases (results not shown). Three females and two males were diagnosed as cases with cancer (results not shown). None of the participants had current or past history of intestinal parasitic infection. A significant difference was observed in the numbers of males and females using iron supplements in the past (1% of males vs. 4% of females). About 10.4% (n = 27) of males were ever smokers; however, only 5.8% (n = 15) were currently smoking cigarettes. None of the female participants was a smoker.

The food frequency questionnaire found that the most frequently consumed food items were red meat (60%), green vegetables (60%), followed by Laban (55%), eggs (47%), tea (30%), cola drinks (20%) and fresh juices (19%). Amongst these red meat and eggs were consumed on frequently basis, whereas green vegetables and Laban were infrequently consumed. Majority reported that food items like tea and cola drinks were consumed only 0 -1 times per week (Table 2). No significant difference was observed in the dietary patterns between males and females (results not shown).

The multiple logistic regression model found that participants reporting intake of red meat (adjusted OR [aOR] 3.4, 95%CI 1.2, 9.7) and intake of Laban (aOR 2.7, 95%CI 1.1, 6.7) for 4- 6 days per week **vs** daily intake were significantly associated with anemia (Table 4). Whereas, obese participants (BMI ≥ 30.00) were protective of having anemia (aOR 0.4, 95%CI 0.2, 0.9) (Table 3). The model was adjusted for age, gender, level of education, smoking, and dietary items (vegetables, tea, juices, eggs).

Discussion

The prevalence of 19.9% is significantly higher than reported by previous studies amongst the same age group in Saudi Arabia [5 – 7]. In our study both males and females showed almost equal prevalence of anemia (19.3% vs 21.2%), which is in contradiction with previous studies that have reported significantly higher prevalence amongst the females [5 -7, 19]. The International review study on anemia reported a prevalence of 10% among people aged >65 years, that increased to 40% among elderly aged >80 years

[20]. We observed an overall increase of 6% in anemia among >60 years with respect to <60 years. Our sample had very few people aged > 80 years (n=4), hence, we are limited in commenting on the increase in this specific group.

The findings related to majority of anemic males in the older age category (> 60 years) can be explained through various mechanisms. It is proven that age leads to increase in pro-inflammatory cytokines, especially IL-6, which in turn inhibits the synthesis of erythropoietin, which may impair the erythroid progenitor cell proliferation, and interferes with iron metabolism [21, 22]. In addition, age-related inflammatory conditions lead to increased cytokine production, which stimulate the liver to release hepcidin, which in turn decreases intestinal absorpstion of iron and decreases the release of iron from macrophages [21]. There is also reason decreased responsiveness of the bone marrow erythroid precursors to stimulatory growth factors with advancing age that may contribute to higher prevalence of anemia among elderly males [22].

Diluted yogurt, Laban, is one of the most ancient, widely consumed, drink in the Arab world [23]. It belongs to the group of fermented food products, containing probiotics [24, 25]. Studies from Middles East, including Saudi Arabia have confirmed the presence of probiotics in yogurt and dairy drinks, including Laban [26, 27]. Probiotics, containing the Lactic Acid Bacteria (LAB) are known to have various beneficial effects including controlling and preventing gastrointestinal problems, allergies, cholesterol and regulating the immune functions [24 -28].

One of the bacilli, the Lactobacillus plantarum is found to assist in the iron absorption from the gut by maintaining acidic environment, acting as an anti-inflammatory agent [29] or by producing iron chelating ligands or by degrading the mineral complexing phytic acid from the food consumed, thus defining its role in preventing iron deficiency anemia [30]. However, there are contradictory findings related to the association between the two [31 – 35]. Interventional study found out that fermented food items increase the absorption of heam and non-heam iron in child-bearing aged women [31, 32]. However, other studies on children and women have failed to establish any positive association between LAB and the iron absorption [33 -35]. Whether the probiotics are important during each stage of life, or they are more health beneficial among the elderly needs to be investigated further. In addition, prospective, interventional study to observe the effect of Laban on the iron stores should be conducted.

The association between intake of red meat and anemia is well established [36]. Red meat is considered an important source for body iron. Heme iron is mainly available through meat intake and may be absorbed up to 50%, whereas non-heme iron is mainly available through fruits, vegetables, and dairy

products (eggs, milk, butter, yogurt) and amounts are variable and depend upon enhancers and inhibitors for iron absorption [36]. Both white and red meat and citrus juices act as enhancers for iron absorption, whereas absorption is inhibited in presence of tea and coffee [36].

It is a general understanding that obesity is negatively associated with health. However, our findings are in support of a large-scale study conducted on Columbian reproductive age group women [37], that found overweight and obese women had lower prevalence of anemia as compared to normal weight. It is recommended that elderly people should consume high caloric diet as they are at risk of malnutrition [38]. In the older people, the daily recommended daily allowance (RDA) of proteins is same as for the younger 0.80 g/kg/day [39]. One explanation may be that despite being obese, they tend to consume diet, which is healthy, and rich in micronutrients, and hence they are at less risk of developing anemia.

Anemia can be both a diagnosis as well as a complication due to other diseases; hence, the earlier it is detected, the better the outcome [12, 13]. Fortunately, the majority of anemics in our study had mild anemia (Hb 11.0 – 12.9 mg/dL). Mild anemia, due to its trivial presentation, is usually ignored; however, complications are associated even with mild anemia [40]. Healthy people suffering from prolonged mild anemia are at increased risk of falls, hospitalizations and develop complications after surgical procedures [41]. Timely diagnosis of anemia reduces the financial burden as well. One single hemoglobin test from a private laboratory costs around 30-35 Saudi Riyal (US$ 9.45) (this is done free of cost in the newly established PHCC), which is quite less in comparison to the cost needed if someone develops severe anemia requiring blood transfusions. Apart from the health hazards, transfusions require a proper laboratory system; hence, health education and early screening for anemia in the elderly is important.

This is one of the first community-based surveys reporting the association between Laban intake and anemia in adults aged >50 years in Riyadh, Saudi Arabia. The number of participants in this age category was less compared to other; however, this distribution supports the actual age pyramid of Saudi Arabia, where a large population consist of children, adolescents and young adults compared to elderly. The findings of this study can be generalized to other urban/semi-urban areas of Saudi Arabia, as Riyadh is the capital and home to different social and ethical groups. Our study also had some limitations. We cannot comment on the type of anemia, as we failed to measure serum ferritin, vitamin B12 or Folate levels. The food frequency questionnaire was not validated hence lack of comparability of the results to those from other studies that have used standard instruments. The design was cross-sectional so that the temporal relation of Laban to anemia cannot be determined.

With increased aging in the Saudi population, the prevalence of anemia will is most likely to increase, causing a burden on the health system and the society. Hence, it is recommended that health education and early screening at the primary health care level should be made mandatory. Future prospective and interventional studies should explore the effect of Laban intake on improving the iron stores and hence hemoglobin among adults and elderly.

Declarations

Ethics approval and consent to participate

- The study protocol was approved by the Institutional Review Board, King Saud University. Informed and signed consent was received from each participant

Consent for publication

- Consent for publication for research purpose was taken from the participant.

Availability of data and material

- The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

- The authors declare that they have no competing interests"

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Author contributions

AMA conceptualized the study, wrote the proposal, and reviewed the manuscript; AK conducted the analysis and contributed towards manuscript writing and reviewing, TAK and AS contributed towards proposal writing, analysis and reviewing the manuscript; HA and AA supervised the data collection, manuscript writing and reviewing. SAS assisted in analysis, and manuscript writing. All authors read and approved the final manuscript.

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Abbreviations

Hb = hemoglobin

MCV = Mean corpuscular volume

MCHC = Mean corpuscular hemoglobin concentration

MCH = Mean Corpuscular Hemoglobin

RBC = Red Blood Cells

RDW = Red Blood Cell Distribution Width

SD = Standard Deviation

CI = Confidence Interval

aOR = Adjusted Odds Ratio

LAB = Lactic Acid Bacteria

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Tables

Table 1: Mean (±SD) of hemoglobin and red blood cell parameters in Saudi males and females aged > 50 -85 years in Riyadh, Saudi Arabia (N = 266)

Variable	Mean (±SD)	Normal Range	Minimum Value	Maximum Value	Inter-quartile Value
Hemoglobin level (g/dl)					
Male	14.3	13-18	9.3	17.9	1.9
Female	(±1.5)	12-16	6.3	17.0	1.4
	12.8				
	(±1.6)				
Red blood cells per mm^3					
Male	5.0	4.7 – 6.1	3.5	8.7	1.3
Female	(±0.5)	4.2 – 5.5	3.9	4.6	0.8
	4.7				
	(±0.4)				
Mean corpuscular volume (μm^3)					
Male	83.5	80-94	60.80	109.8	8.7
Female	(±12.1)	80-94	46.20	104.0	11.3
	79.7				
	(±18.1)				
Mean corpuscular hemoglobin (pg)					
Male					
Female	28.5	27-32	18.9	78.9	3.2
	(±5.0)	27-32	17.0	32.3	3.4
	26.5				
	(±2.9)				
Mean corpuscular hemoglobin concentration (g/dl)					
Male	33.1	32-36	20.0	39.4	3.4
Female	(±2.9)	32-36	23.5	38.1	4.1
	32.1				
	(±3.1)				

Red cell distribution width (%)					
Male	13.5	11.5-14.5	11	19	1.0
Female	(±1.3)	11.5-14.5	12	19	1.0
	13.7				
	(±1.5)				

Table 2: Unadjusted odds ratios (OR) and 95% confidence intervals (CI) for factors associated with Anemia in Saudi participants aged > 50-85 years in Riyadh, Saudi Arabia

Sociodemographic characteristics	All N=266	Anemic n=53 (19.9%)	Normal n=213 (80.1%)	Unadjusted OR (95% CI)
Gender				
Males	186 (69.9)	36 (67.9)	150 (70.4)	1.0
Females	80 (30.1)	17 (32.1)	63 (29.6)	1.1 (0.6, 2.1)
Age (in years)				
>50 - 60 years	136 (51.1)	25 (47.2)	111 (52.1)	1.0
≥61 - 85 years	130 (48.9)	28 (52.8)	102 (47.9)	1.2 (0.7,2.2)
Marital status				
Married	244 (91.7)	48 (90.6)	196 (92.0)	1.0
Divorced/widow	22 (8.3)	5 (9.4)	17 (8.0)	0.8 (0.3, 2.4)
Educational level				
Secondary and above	131 (49.2)	19 (35.8)	112 (52.6)	**1.0**
Primary and less	135 (50.8)	34 (64.2)	101 (47.4)	**2.0 (1.1, 3.7)***
Type of Housing				
House	141 (53.0)	25 (47.2)	116 (54.5)	1.0
Apartment	125 (47.0)	28 (52.8)	97 (45.5)	1.3 (0.7, 2.4)
Occupation				
Working	95 (35.7)	13 (24.5)	82 (38.5)	**1.0**
Retired/ Housewife	171 (64.3)	40 (75.5)	131 (61.5)	**1.9 (1.0, 3.1)***
Body Mass Index				
<25.00	47 (17.7)	12 (22.6)	35 (16.4)	1.0
25.0- 29.99	111 (41.7)	24 (45.3)	87 (40.8)	0.8 (0.4, 1.8)
≥ 30.00	108 (40.6)	17 (32.1)	91 (42.7)	0.5 (0.2, 1.3)
Smoking history				
No	228 (85.7)	48 (92.4)	179 (84.0)	1.0
Yes	38 (14.3)	5 (7.6)	34 (16.0)	0.4 (0.1, 1.3)
Medical history				
Peptic Ulcer				

No	253 (95.1)	48 (96.2)	202 (94.8)	1.0
Yes	13 (4.9)	2 (3.8)	11 (5.2)	0.7 (0.2, 3.3)
Hemorrhoids				
No	257 (96.6)	51 (96.2)	206 (96.7)	1.0
Yes	9 (3.4)	2 (3.8)	7 (3.3)	1.1 (0.2, 5.7)
Cancers (any type)				
No	263 (98.9)	52 (98.1)	211 (99.1)	1.0
Yes	3 (1.1)	1 (1.9)	2 (0.9)	2.0 (0.2, 22.8)

[a]). Numbers are percentages unless otherwise stated;

*statistically significant ($p<0.05$)

Table 3: Frequency of weekly intake of common dietary items and their association with anemia in Saudi participants aged >50 - 85 years in Riyadh, Saudi Arabia

Dietary items	All N=266	Anemic n=53 (19.9%)	Normal n=213 (80.1%)	Unadjusted OR (95% CI)
Red Meat				
Frequently	53 (19.9)	6 (11.3)	47 (22.1)	1.0
Infrequently	107 (40.2)	31 (58.5)	76 (35.7)	**3.2 (1.2, 8.2)**
Never	106 (39.8)	16 (30.2)	90 (42.3)	1.4 (0.5, 3.8)
Green Vegetables				
Frequently	84 (31.6)	16 (30.2)	68 (31.9)	1.0
Infrequently	76 (28.6)	16 (30.2)	60 (28.2)	1.1 (0.5, 2.5)
Never	106 (39.8)	21 (39.6)	85 (39.9)	1.1 (0.5, 2.2)
Tea/coffee				
Frequently	47 (17.7)	11 (20.8)	36 (16.9)	1.0
Infrequently	32 (12.0)	8 (15.1)	24 (11.3)	1.1 (0.4, 3.1)
Never	187 (70.3)	34 (64.2)	153 (71.8)	0.7 (0.3, 1.6)
Laban				
Frequently	89 (33.5)	14 (26.4)	75 (35.2)	1.0
Infrequently	61 (22.9)	18 (34.0)	43 (20.2)	**2.2 (1.02, 4.9)**
Never	116 (43.6)	21 (39.6)	95 (44.6)	1.2 (0.7, 2.5)
Cola drinks				
Frequently	26 (9.8)	6 (11.3)	20 (9.4)	1.0
Infrequently	34 (12.8)	10 (18.9)	24 (11.3)	1.4 (0.4, 4.5)
Never	206 (77.4)	37 (69.8)	169 (79.3)	0.7 (0.3, 1.9)
Fresh juices				
Frequently	24 (9.0)	5 (9.4)	19 (8.9)	1.0
Infrequently	27 (10.2)	5 (9.4)	22 (10.3)	0.9 (0.2, 3.9)
Never	215 (80.8)	43(81.4)	172 (80.8)	1.2 (0.4, 3.8)
Eggs				
Frequently	58 (21.8)	11(20.8)	47 (22.1)	1.0
Infrequently	51 (24.7)	15 (28.3)	36 (16.9)	1.8 (0.7, 4.3)
Never	157 (59.0)	27 (50.9)	130 (61.0)	0.9 (0.4, 1.9)

[a] Frequent = 5-7 days/week; Infrequent = 2-4 days and never = 0 and 1 per week

[a]). Numbers are percentages unless otherwise state

Table 4: Multivariable logistic regression model showing association between dietary items and Anemia in Saudi participants aged >50 - 85 years in Riyadh, Saudi Arabia

Variable	Adjusted Odds Ratio (95% CI)
Red Meat	
Frequently	**1.0**
Infrequently	**3.4 (1.2, 9.7)**
Never	1.4 (0.5, 4.4)
Laban	
Frequently	**1.0**
Infrequently	**2.7 (1.1, 6.7)**
Never	1.2 (0.5, 2.6)
Body Mass Index	
<25.00	1.0
25.0- 29.99	0.6 (0.3, 1.5)
≥ 30.00	**0.4 (0.2, 0.9)***

Model adjusted for gender, age, education level, smoking and dietary items (vegetables, tea, juices, eggs)

*$p < 0.05$

Figures

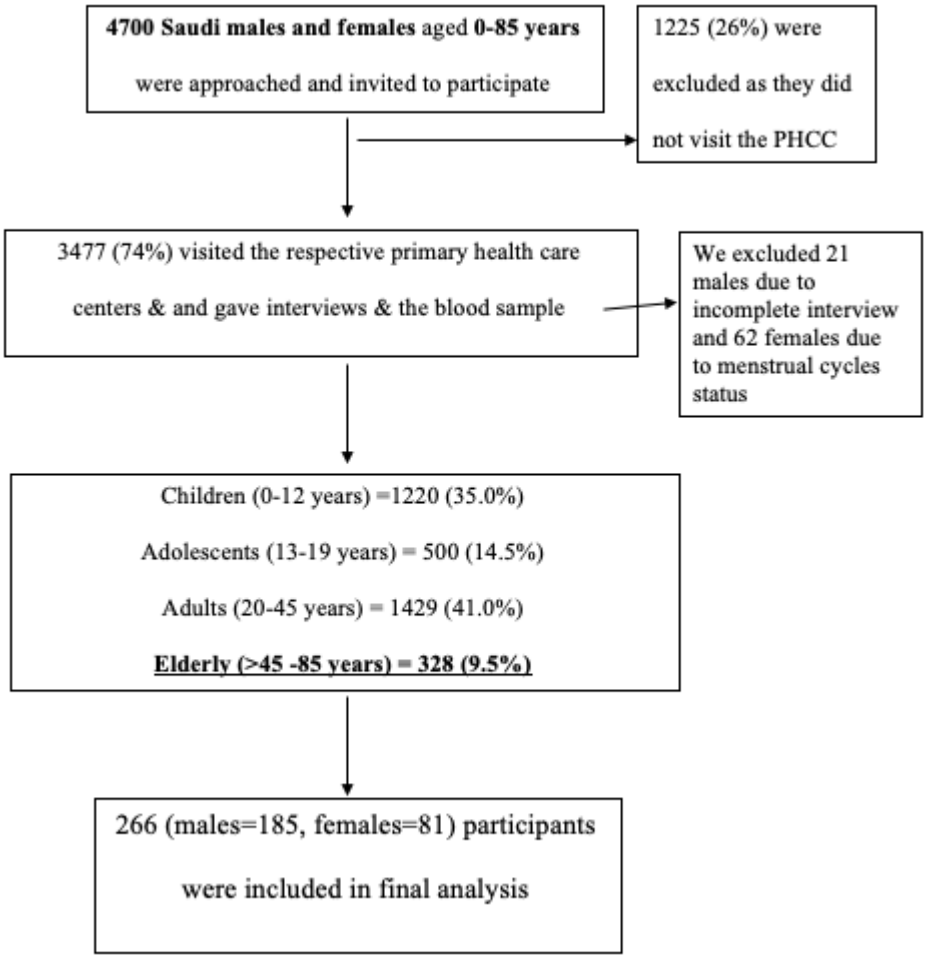

Figure 1

Flow chart showing the number of Saudi adult participants aged >50 years in Riyadh, Saudi Arabia

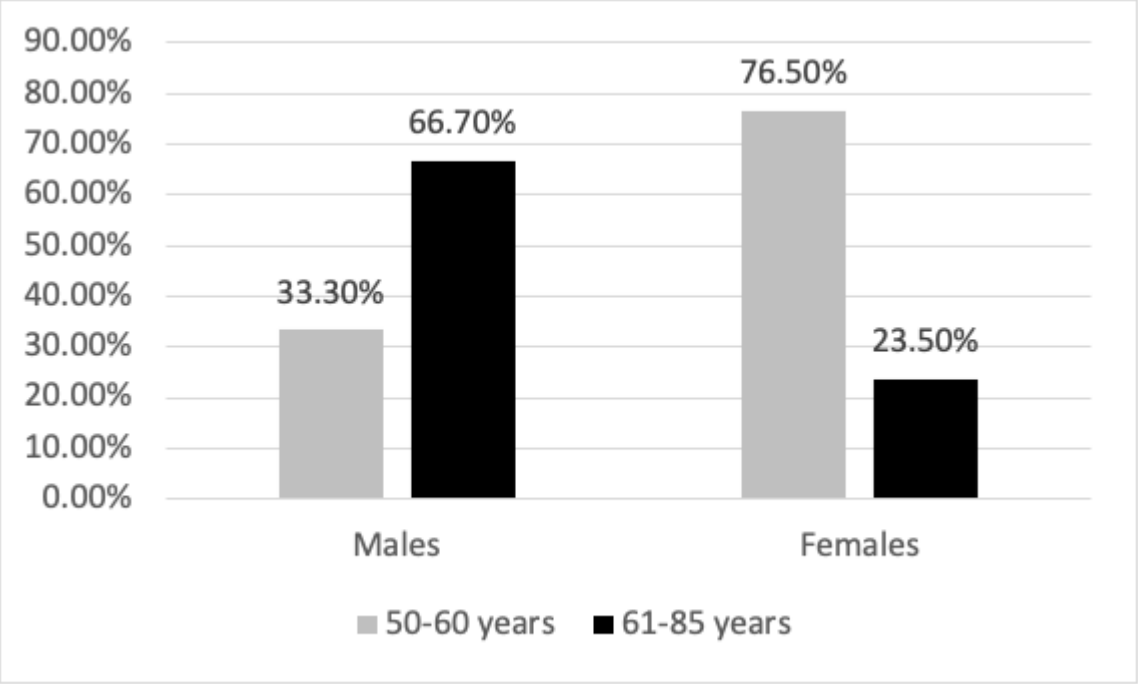

Figure 2

Percentage of anemic males and females by the age categories in Riyadh, Saudi Arabia