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Prevalence and associated factors of anemia among adult male patients at Security Forces Hospital in Makkah, Saudi Arabia

Rana Ghazi Zaini[1*], Rana Barnawi[1], Tamadur Baz[1], Mohammad Algahtani[2]

1. Clinical Laboratory, Taif University, Taif, Saudi Arabia
2. Clinical Laboratory, Security Forces Hospital, Makkah, Saudi Arabia

ABSTRACT

Background: Anemia in adult males is an underrecognized condition that may reflect nutritional deficiencies, chronic disease, or inflammation. Data on the prevalence of anemia and its associated factors among adult males attending healthcare facilities in Saudi Arabia remain limited. This study aimed to determine the prevalence of anemia and identify associated demographic, lifestyle, and clinical factors among adult male patients at a Security Forces Hospital.

Methods: A cross-sectional study was conducted among 568 adult male patients aged ≥18 years. Blood samples were analyzed using automated hematology analyzers to assess blood count parameters. Anemia was defined according to World Health Organization criteria as hemoglobin <13 g/dL. Demographic, lifestyle, and clinical data were collected. Associations between anemia and independent variables were assessed using chi-square and independent t-tests, with $p<0.05$ considered statistically significant.

Results: The prevalence of anemia was 15.8%. Anemia increased significantly with age ($p<0.001$), with the highest prevalence among participants aged 55–64 years. Physical inactivity, iron supplementation use, and conception of iron-rich food were significantly associated with anemia ($p<0.05$). Most cases were mild (65.6%), and microcytic hypochromic anemia was the predominant morphological type (52.2%). Iron studies showed low serum iron levels in more than half of the tested participants.

Conclusions: Anemia is common among adult male patients, particularly in older age groups. Iron deficiency appears to be a major contributor, although multiple etiologies are likely. These findings support routine anemia screening and preventive strategies among adult males in hospital settings.

Keywords: adult males, anemia, hemoglobin, prevalence, risk factors

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INTRODUCTION

Anemia remains a major global public health problem, affecting individuals across all age groups and both genders, with significant consequences for morbidity, work productivity, and quality of life [1]. According to the World Health Organization (WHO), anemia in adult males is defined as an abnormal decrease in the concentration of hemoglobin below 13 g/dL and is often underdiagnosed due to its nonspecific clinical presentation [2]. The total prevalence of anemia is generally lower in males compared to females and children [3]. However, anemia in adult men frequently reflects underlying pathological conditions rather than a normal physiological process and warrants careful evaluation [4].

The etiology of anemia among adult males is multifactorial, encompassing nutritional deficiencies such as iron, vitamin B12, and folate deficiency, chronic infections, inflammatory disorders, renal insufficiency, gastrointestinal blood loss, and malignancies. In many cases, anemia may be the first laboratory indicator of serious underlying disease [5,6]. Demographic and lifestyle factors including age, education level, income, smoking status, dietary habits, physical activity, and comorbid conditions may influence the prevalence and severity of anemia in this population [6-8].

Despite its clinical importance, data on the prevalence and determinants of anemia among adult males remain limited, particularly in hospital-based and regional settings [6-8]. Many studies focus primarily on women of reproductive age, children, or elderly populations, leaving a gap in understanding the burden of anemia among adult men. Identifying the prevalence and associated risk factors in this group is essential for early detection,

* Corresponding author: Rana Ghazi Zaini, Clinical Laboratory, Taif University, Saudi Arabia. E-mail: ranazaini2@tu.edu.sa

appropriate clinical management, and development of targeted preventive strategies.Therefore, this study aims to determine the prevalence of anemia among adult male patients and to identify key demographic and lifestyle factors associated with anemia. The findings of this study are expected to contribute valuable local data and support evidence-based approaches to the targeted evaluation and treatment of anemia, particularly among individuals with risk factors or clinical signs and symptoms.

METHODS

Study design and setting

This study was conducted in Security Forces Hospital at Makkah City, located in the Western Region of Saudi Arabia, to evaluate the prevalence and associated factors of anemia among adult male patients. The study population consisted of males aged 18 years and above, and data were collected between March 2025 and September 2025. A total of 568 participants were included. Individuals who declined to participate or did not complete the study questionnaire were excluded from the study. All participants provided informed consent prior to enrolment. Patients with known genetic hematological disorders (e.g., sickle cell anemia) or active bleeding were also excluded.

Sample characteristics and data collection

Adult male participants were enrolled throughout the study period after providing written informed consent. The study population represented a wide range of educational levels and socioeconomic backgrounds. Data on demographic characteristics (age, education level, employment status, and income), lifestyle factors (smoking status, dietary habits, and physical activity), and clinical history (presence of chronic medical conditions) were collected using a structured questionnaire. Venous blood samples were obtained from all participants to determine anemia status using hematological and biochemical analyses. Participants with substantial missing questionnaires data, missing laboratory results, or those who declined consent were excluded from the final analysis.

Questionnaire

A pretested, structured questionnaire in the local language (Arabic) was used for data collection. The questionnaire was designed to obtain information on demographic characteristics, socioeconomic status, lifestyle habits, and health-related factors potentially associated with anemia. It consisted of two main sections. The first section included demographic and socioeconomic variables such as age, nationality, marital status, education level, employment status, monthly income, and place of residence. The second section addressed medical history and health-related factors, including previous diagnosis of anemia, presence of chronic medical conditions, anemia-related symptoms, dietary habits with emphasis on iron-rich foods, use of iron supplements or vitamins, and regular health checkups. The questionnaire was pretested to ensure clarity, cultural appropriateness, and ease of understanding prior to administration.

Clinical assessment and laboratory testing

Participants were recruited from the emergency department and several outpatient clinics at Security Forces Hospital, including Internal medicine, Urology, General Surgery, Respiratory Medicine, and Family Medicine services. All participants were ambulatory patients attending outpatient services and were not hospitalized at the time of the study. Eligible participants were identified based on the study inclusion and exclusion criteria. All participants underwent a clinical assessment conducted by a physician, which included medical history taking and physical examination. Following the clinical assessment, laboratory investigations were ordered to assess anemia status.

Venous blood samples were collected from all participants by trained laboratory personnel using both ethylenediaminetetraacetic acid (EDTA) and heparinized tubes under standard aseptic conditions. Hematological parameters were analyzed in the hematology laboratory using the Sysmex XN-2000 automated hematology analyzer. Complete blood count (CBC) measurements included hemoglobin concentration (HB), red blood cell count, hematocrit, mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH). These parameters were used to assess anemia status, severity, red blood cell morphology and enabling classification into microcytic hypochromic, normocytic normochromic, and macrocytic anemia and assessment of red blood cell morphological characteristics.

Biochemical investigations were performed in the biochemistry laboratory using the Alinity-ci system analyzer to assess iron status. Serum iron and serum ferritin levels were measured to evaluate iron status and determine the presence or absence of iron deficiency anemia (IDA), with reduced levels indicating depleted iron stores and impaired hemoglobin synthesis. Biochemical findings were interpreted in conjunction with hematological parameters, including hemoglobin concentration and red cell indices to identify the type of anaemia and characterize the underlying etiology.

Statistical analysis

Data were processed and analyzed using Microsoft Excel. All completed questionnaires were reviewed for accuracy, completeness, and consistency prior to analysis. Variables were appropriately labeled and coded. Con-

tinuous variables, including hemoglobin levels, were recorded as numerical values, while categorical variables such as age group, marital status, education level, income, smoking status, dietary habits, physical activity, and presence of chronic medical conditions were categorized into analytical groups to allow meaningful comparisons.

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participant demographic characteristics, lifestyle factors, and clinical variables. Anemia status was defined according to the World Health Organization (WHO) criteria for adult males (hemoglobin < 13 g/dL). Comparative analyses were conducted to examine associations between anemia status and independent variables. The Chi-square test was used for categorical variables, while the independent t-test was applied to compare mean hemoglobin levels between groups. A *p*-value of < 0.05 was considered statistically significant.

Ethical considerations

The proposal of this study was approved by the ethics committee of the College of Applied Medical Science at Taif University, with official approval granted via institutional email. Additionally, this study has received ethical clearance from Institutional Review Board (IRB) at Security Forces Hospital program in Makkah, under IRB number 0776-301224. Participation in this study was completely voluntary. Each individual was notified about the purpose of the research, and they have their right to withdraw their collected information any time without any consequences. Verbal informed consent was obtained from all participants prior to data collection in compliance with the approved ethical procedure. To maintain confidentiality, all patients' personal information was removed from the data collection tools, besides it will be maintained throughout the study as well as after the study ends.

RESULTS

Participants were enrolled from multiple outpatient clinics and the emergency department at a Security Forces Hospital, including internal medicine, urology, general surgery, respiratory medicine, and family medicine services. A total of 568 participants were included in the analysis. Among them, 90 participants were identified as anemic, corresponding to an overall anemia prevalence of 15.8%. Descriptive and comparative analyses were performed to examine the distribution of anemia across sociodemographic characteristics, lifestyle factors, dietary habits, and clinical variables (Table 1), as well as to assess their associations with anemia status.

Age and anemia

Anemia prevalence demonstrated a clear and progressive increase with advancing age. No cases of anemia were observed among participants aged 18–24 years (0% of anemic cases, n = 0; 0/32 within this age group). A low prevalence was observed in the 25–34 age group, representing 2.2% of all anemia cases (n=2), corresponding to 3.3% (2/60) of individuals in this age category. The proportion increased to 11.1% of anemia cases (n=10) among participants aged 35–44 years, which corresponds to 7.6% (10/132) within this age group. Similarly, individuals aged 45–54 years accounted for 13.3% of anemia cases (n=12), representing 14.3% (12/84) of participants in this category. A marked rise was observed among older participants, with individuals aged 55–64 years accounting for the highest proportion of anemia cases at 40.0% (n=36), corresponding to 23.4% (36/154) of participants in this age group. Among those older than 65 years, 33.3% of anemia cases (n=30) were reported, representing 28.3% (30/106) of individuals in this age category. A Chi-square test of independence demonstrated a statistically significant association between age group and anemia status ($\chi^2(5, n=568) = 38.88$, $p<0.001$), indicating a higher prevalence of anemia with advancing age (Table 1).

Nationality and anemia

Saudi nationals constituted the majority of participants 99.3% (n=564), of whom 90 individuals were anemic (15.8%), whereas none of the four non-Saudi participants were found to be anemic (Table 1). Due to the highly skewed nationality distribution and the very small number of non-Saudi participants, statistical testing was not considered reliable, and no Chi-square p-value was reported. The observed difference likely reflects the institutional population served by Security Forces Hospital rather than nationality being an independent risk factor for anemia.

Marital status and anemia

In this study, the majority of participants were married 86.3% (n=490). Among anemic participants (n=90), most were married 95.6% (n=86), while 4 anemic cases (4.4%) were single. No cases of anemia were observed among divorced participants. Chi-square analysis demonstrated no statistically significant association between marital status and anemia ($p>0.05$); however, interpretation is limited by the small number of participants in some subgroups.

Educational level and anemia

Among anemic participants (n=90), educational level varied across categories. The highest proportion of anemic individuals had higher education 44.4% (n=40), followed by secondary education 26.7% (n=24) and primary education 20.0% (n=18), while a smaller proportion

had no formal education 8.9% (n=8) (Table 1). Despite these observed differences in the distribution of anemia across educational levels, Chi-square analysis revealed no statistically significant association between educational level and anemia status ($p>0.05$).

Employment status and anemia

Regarding employment status, retired individuals constituted the largest proportion of the study population 51.1% (n=290). Among anemic participants (n=90), the majority were retired 75.6% (n=68), followed by those employed full-time 20.0% (n=18). Smaller proportions of anemic participants were part-time employed 2.2% (n=2) or unemployed 2.2% (n=2), while no cases of anemia were observed among self-employed individuals or students. In the non-anemic group (n=478), full-time employment was most common 46.0% (n=218), followed by retired status 46.4% (n=222) (Table 1). Chi-square analysis showed no statistically significant association between employment status and anemia ($p>0.05$).

Table 1. Distribution of anemia according to demographic and clinical characteristics

Variable	Category	All (n=568)	Anemic (n=90)	Non-anemic (n=478)
Age (years)	18–24	32 (5.6%)	0 (0.0%)	32 (6.7%)
	25–34	60 (10.6%)	2 (2.2%)	58 (12.1%)
	35–44	132 (23.2%)	10 (11.1%)	122 (25.5%)
	45–54	84 (14.8%)	12 (13.3%)	72 (15.1%)
	55–64	154 (27.1%)	36 (40.0%)	118 (24.7%)
	>65	106 (18.7%)	30 (33.3%)	76 (15.9%)
Nationality	Saudi	564 (99.3%)	90 (100.0%)	474 (99.2%)
	Non-Saudi	4 (0.7%)	0 (0.0%)	4 (0.8%)
Marital status	Single	72 (12.7%)	4 (4.4%)	68 (14.2%)
	Married	490 (86.3%)	86 (95.6%)	404 (84.5%)
	Divorced	6 (1.0%)	0 (0.0%)	6 (1.3%)
	Widowed	0 (0.0%)	0 (0.0%)	0 (0.0%)
Educational level	No formal education	20 (3.5%)	8 (8.9%)	12 (2.5%)
	Primary education	86 (15.1%)	18 (20.0%)	68 (14.2%)
	Secondary education	238 (42.0%)	24 (26.7%)	214 (44.8%)
	Higher education	224 (39.4%)	40 (44.4%)	184 (38.4%)
Employment status	Full-time	236 (41.5%)	18 (20.0%)	218 (46.0%)
	Part-time	4 (0.7%)	2 (2.2%)	2 (0.4%)
	Self-employed	2 (0.4%)	0 (0.0%)	2 (0.4%)
	Retired	290 (51.1%)	68 (75.6%)	222 (46.4%)
	Student	24 (4.2%)	0 (0.0%)	24 (5.0%)
	Unemployed	12 (2.1%)	2 (2.2%)	10 (2.1%)
Monthly income (SAR)	<3000	30 (5.3%)	4 (4.4%)	26 (5.4%)
	3000–7000	100 (17.6%)	18 (20.0%)	82 (17.2%)
	>7000	254 (44.7%)	34 (37.8%)	220 (46.0%)
	Prefer not to say	184 (32.4%)	34 (37.8%)	150 (31.4%)
Residence	Urban	526 (92.6%)	80 (88.9%)	446 (93.3%)
	Rural	42 (7.4%)	10 (11.1%)	32 (6.7%)
Smoking status	Smoker	90 (15.8%)	12 (13.3%)	88 (18.4%)
	Non-smoker	478 (84.2%)	78 (86.7%)	390 (81.6%)
Physical activity	Regular activity	176 (31.0%)	20 (22.2%)	156 (32.6%)
	No activity	392 (69.0%)	70 (77.8%)	322 (67.4%)
Vegan diet	Yes	4 (0.7%)	0 (0.0%)	4 (0.8%)
	No	564 (99.3%)	90 (100.0%)	474 (99.2%)
Chronic condition	Yes	334 (58.8%)	48 (53.3%)	286 (59.8%)
	No	234 (41.2%)	42 (46.7%)	192 (40.2%)
Iron supplementation	Yes	106 (18.7%)	28 (31.1%)	78 (16.3%)
	No	462 (81.3%)	62 (68.9%)	400 (83.7%)
Iron-rich food intake	Daily	210 (37.0%)	20 (22.2%)	190 (39.7%)
	Few times/week	264 (46.5%)	38 (42.2%)	226 (47.3%)
	Rarely	88 (15.5%)	30 (33.3%)	58 (12.1%)
	Never	6 (1.0%)	2 (2.2%)	4 (0.8%)
Regular health checkup	Yes	463 (81.5%)	80 (88.9%)	381 (79.7%)
	No	105 (18.5%)	10 (11.1%)	97 (20.3%)

Monthly income and anemia

The result of this study showed that the largest proportion of participants reported an income greater than 7,000 Saudi Riyal (SAR) 44.7% (n=254), followed by those who preferred not to disclose their income (32.4%, n=184). Among anemic participants (n=90), equal proportions reported a monthly income greater than 7,000 SAR and preferred not to state their income each 37.8% (n=34), while 20.0% (n=18) reported an income between 3,000 and 7,000 SAR and 4.4% (n=4) reported an income below 3,000 SAR. In the non-anemic group (n=478), most participants reported a monthly income greater than 7,000 SAR 46.0% (n=220) (Table 1). Chi-square analysis revealed no statistically significant association between monthly income and anemia status (p>0.05).

Residence and anemia

Regarding the place of residence, the majority of participants in this study resided in urban areas, that is 92.6%, (n=526), while a smaller proportion lived in rural areas 7.4% (n=42). Among anemic participants (n=90), most were from urban settings, that is 88.9% (n=80), with a higher relative representation of rural residents 11.1% (n=10) compared with the non-anemic group. In the non-anemic group (n=478), 93.3% (n=446) resided in urban areas and 6.7% (n=32) in rural areas (Table 1). No statistically significant association was observed between place of residence and anemia status (p>0.05).

Smoking Status and Anemia

Most participants were non-smokers 84.2% (n=478), while smokers constituted 15.8% (n=90) of the study population. Among anemic participants (n=90), the majority were non-smokers 86.7% (n=78), whereas 13.3% (n=12) were smokers (Table 1). Chi-square analysis showed no statistically significant association between smoking status and anemia (p>0.05).

Physical activity and anemia

Among anemic participants (n=90), the majority reported no physical activity 77.8% (n=70), while a smaller proportion reported engaging in regular physical activity 22.2% (n=20) (Table 1). Comparison of physical activity status between anemic and non-anemic participants demonstrated a statistically significant association, as determined by Chi-square analysis ($\chi^2(1) = 3.89$, p=0.049). This finding indicates that physical activity status differed significantly between the two groups, with physical inactivity being more frequently observed among individuals with anemia.

Vegan diet and anemia

Only four participants reported following a vegan diet, and none were anemic. Due to the very small number of vegan participants (Table 1), Chi-square analysis showed no statistically significant association (p=1.000), and meaningful interpretation was limited.

Chronic conditions and prior diagnosis of anemia

Among the 90 anemic participants, 53.3% (n=48) reported having at least one chronic disease, while 46.7% (n=42) had no chronic medical conditions (Table 1). Among anemic participants with chronic disease, the majority had both diabetes mellitus and hypertension 66.7% (n=32), followed by hypertension alone 20.8% (n=10) and diabetes mellitus alone 12.5% (n=6). Comparison of chronic disease status between anemic and non-anemic participants revealed no statistically significant association with anemia ($\chi^2(1) = 1.68$, p=0.195). Importantly, despite confirmed anemia at the time of the study, only 22 anemic participants reported having been previously diagnosed with anemia, indicating a substantial proportion of undiagnosed cases.

Iron supplement use and anemia

Iron supplementation was reported by 106 participants (18.7%) overall. Among anemic patients (n=90), 31.1% (n=28) individuals were receiving iron supplements, while the majority, 68.9% (n=62) were not using iron supplementation. In contrast, iron supplement use was lower among non-anemic participants, with 16.3% individuals (n=78) reporting supplementation, whereas 83.7% (n=400) were not using iron supplements (Table 1). Chi-square analysis demonstrated a statistically significant association between iron supplement use and anemia status ($\chi^2(1) = 12.99$, p<0.001).

Consumption of iron-rich foods and anemia

Among anemic patients (n=90), only 22.2% (n=20) reported daily intake of iron-rich foods, while 35.5% (n=32) reported rare or no intake. In contrast, few times a week intake of iron-rich foods was more common among non-anemic participants 47.3% (n=226) (Table 1). Chi-square analysis demonstrated a statistically significant association between iron-rich food intake and anemia status (p<0.05).

Regular health checkups and anemia

The result of this study showed that most participants reported undergoing regular health checkups (81.5%). Among anemic patients (n=90), 80 individuals (88.9%) reported regular health checkups, compared with 381 non-anemic participants (79.7%). Chi-square analysis showed no statistically significant association between regular health checkups and anemia status ($\chi^2(1, N=568) = 3.60$, p=0.058).

Hemoglobin levels and anemia severity

Among the study population, 90 male participants (15.8%) were classified as anemic, while the remaining 478 participants (84.2%) were non-anemic. Hemoglobin levels among anemic participants showed a mean concentration of 11.33 ± 1.38 g/dL, compared with a significantly higher mean hemoglobin level of 14.71 ± 1.19 g/dL among non-anemic participants. An independent-samples t-test was performed to compare mean hemoglobin levels between anemic and non-anemic participants, demonstrating a statistically significant difference between the two groups (p<0.001). Severity of anemia among anemic participants was classified according to the WHO, hemoglobin thresholds [9]. Based on this classification, 59 participants (65.6%) had mild anemia (Hb 11.0–12.9 g/dL) and 29 participants (32.2%) had moderate anemia (Hb 8.0–10.9 g/dL), while no cases of severe anemia (Hb < 8.0 g/dL) were identified, indicating that anemia in this cohort was predominantly mild in severity. Consistent with these findings, the mean hematocrit level among participants was 34.7%, with a median value of 36.3%, which is below the normal reference range for adult males (approximately 41–53%), further supporting the presence of anemia in the study population.

Classification of anemia based on RBC indices

Morphological classification of anemia was performed for all anemic participants (n=90) using mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) values to characterize red blood cell size and hemoglobin content. The analysis revealed a predominance of microcytic hypochromic anemia, which was identified in 52.2% (n=47) of cases. This morphological pattern is typically associated with iron deficiency and is consistent with the high proportion of participants exhibiting low serum iron levels in this cohort. Although microcytic hypochromic anemia strongly indicates iron deficiency, other causes such as thalassemia trait or chronic inflammatory conditions cannot be completely excluded due to the lack of additional diagnostic tests. Normocytic normochromic anemia was the second most common pattern, observed in 35.6% (n=32) of anemic participants, suggesting the presence of anemia of chronic disease or other non-iron-deficiency etiologies. It is important to note that early iron deficiency may present with normocytic normochromic red blood cell indices, as reductions in MCV and MCH typically occur only in later stages of iron depletion.

Less frequent morphologic patterns included normocytic hypochromic anemia in 7.8% (n=7) of cases which may reflect early iron deficiency or mixed nutritional and inflammatory processes. Microcytic normochromic anemia and macrocytic normochromic anemia were uncommon, each accounting for 2.2% of cases (n=2). Overall, these findings demonstrate that anemia in this population is morphologically heterogeneous, with a predominance of iron-related microcytic hypochromic anemia alongside a substantial proportion of normocytic patterns, highlighting the likelihood of multiple underlying etiologies contributing to anemia in this cohort.

Descriptive statistics of iron studies

Serum iron and ferritin measurements were available for 66 of the 90 anemic participants included. in the study and were analyzed using descriptive statistical methods. These tests were not performed for all patients because iron studies were occasionally unavailable in the hospital laboratory or were requested by the treating physicians based on clinical evaluation.

Iron status was classified according to the World Health Organization, the normal reference range for serum iron in adult males is approximately 11-33µmol/L, while normal serum ferritin levels generally range less than 30 ng/mL [10,11]. Based on the available iron studies performed in a subset of anemic participants (n=66), the mean serum iron level was 10.72 µmol/L, with a median value of 9.3 µmol/L and a wide range of 3.4–23.1 µmol/L, indicating that many participants had values at or below the lower limit of normal. The mean serum ferritin level was 127.42 ng/mL, with a median of 104.18 ng/mL and a broad range extending from 5.59 to 568.94 ng/mL, reflecting considerable variability in iron stores among the anemic participants.

DISCUSSION

This study attempted to assess the prevalence of anemia and provide important insight regarding its severity, and determinants among adult male patients attending Security Forces Hospital in Makkah, Saudi Arabia. The overall prevalence of anemia in this study was 15.8%, demonstrating that anemia is a prevalent illness among adult men and should not be overlooked in medical care. A higher prevalence of anemia was reported by the National Nutrition Monitoring Bureau in 2006, with 54.8% of men aged 20 years and older across nine states of the country [12]. However, a cross-sectional study conducted at Jazan University in 2020 found that 5% of male students participants were anemic, with anemia mainly associated with low dietary iron intake and irregular meal consumption [13].

The result of this study revealed a significant link between increasing age and the incidence of anemia. The prevalence significantly rose with age, reaching its peak among patients between 55–64 years old. This pattern aligns with numerous prior studies indicating elevated anemia rates in older men, likely due to age related physiological and functional changes, such as diminished bone

marrow reserve, nutritional deficiencies, chronic inflammation, renal insufficiency, and undetected hemorrhage [14]. A long-term cohort study found that the prevalence of anemia and the complexity of its underlying causes increases with age, and that anemia in elderly people correlates with an elevated risk of all-cause mortality, underscoring its clinical importance in this age range [15]. These alterations may influence the progression of anemia in several ways by functioning collaboratively rather than independently. Anemia in older men is often neglected or ascribed to the aging process, despite its correlation with increased morbidity, functional deterioration, and reduced quality of life [16] Similarly, a large European study encompassing older adults from several countries indicated an anemia prevalence of approximately 6.5%, with a notable increase in frequency correlated with advancing age [17] Our results underscore the necessity for regular hemoglobin evaluation in elderly male patients, especially those with comorbidities.

The result of the present study showed that the majority among participants were Saudi, and all documented instances of anemia were confined to this group. The observed distribution reflects the hospital population rather than nationality as an independent risk factor for anemia. However, our findings also reported that no statistically significant correlations were found between anemia and marital status, educational level, employment status, income, residence, vegan diet or smoking habits. Similar results have been reported in other hospital-based research, which likewise did not reveal significant associations between anemia and these sociodemographic or lifestyle factors [16]. The lack of significant relations may be attributed to the highly homogeneous study population and the hospital-based design, which may restrict diversity in socioeconomic variables. Moreover, the dependence on self-reported data and limited subgroup sizes may have limited the statistical power to identify significant differences. In contrast, population-based studies have revealed significant difference in anemia prevalence, with educational level and wealth contributing as significant factors [18].

A significant correlation existed between reduced physical activity and an increased incidence of anemia. This association may be bidirectional, as people exhibiting physical inactivity often have worse general health, while anemia may independently induce weariness and impair exercise ability. Previous studies demonstrate that participants with anemia frequently have reduced physical activity levels and decreased physical functioning in comparison to those without anemia[19]. Moreover, regular exercising has been linked to elevated hemoglobin and ferritin levels, indicating that sufficient exercise may aid in maintaining the level of iron [20].

Througout the study, 44% of anemic individuals have history of chronic diseases; 31% of these people had both diabetes and hypertension, 11% had hypertension, whereas 13.3% were diabetic. Although several anemic people have chronic health conditions, no statistically significant correlation was found between anemia and chronic illnesses. This finding contrasts with previous studies that have demonstrated a relationship between chronic diseases and anemia. Hypertension has been found to be positively associated with anemia in larger cohort studies; however, this association could be due the absence of antihypertensive drug use among people with newly diagnosed hypertension in some regions [21]. Recent research among Romanian patients indicate that anemia frequently coexists with type 2 diabetes, affecting around one-third of diabetic patients, especially those with other associated chronic medical conditions such as chronic kidney disease and other comorbid conditions [22]. On the other hand, diabetes has been suggested to be considered by monitoring Hb and RBCs level since they tend to be low according to WHO criteria, and they suggest that diabetic patients must be encouraged to improve their dietary nutrition and taking iron supplementation pills [23]. The lack of statistical significance in the current study may be attributed to the nature of the study population, which was hospital-based and had a substantial number of individuals with preexisting medical issues potentially affecting the outcomes.

The findings of this study highlight the clinical importance of undiagnosed anemia, as more than three-quarters of affected participants were unaware of their condition prior to diagnosis.This may be related to the prevalence of mild anemia among the research population, which is frequently asymptomatic or linked to mild symptoms that are commonly neglected. Anemia in adult males is often underdiagnosed in clinical settings, as screening is typically not conducted until symptoms are significant or complications occur which aligns with recent research indicating significant lack of awareness of iron deficiency anemia within adult population. A study conducted among adults in Makkah, Saudi Arabia, revealed that most participants had a poor knowledge of iron deficiency anemia and related prevention strategies, underscoring significant deficiencies in public awareness [24].

In this study, the results showed a significantly higher proportion of iron supplementation use among anemic participants compared with non-anemic participants. The higher use of iron supplementation among anemic participants likely reflects treatment following diagnosis, with some participants possibly having been previously diagnosed with anemia, rather than a causal relationship. Moreover, findings from a systematic review of randomized trials involving iron-deficient adults indicate that

iron supplementation correlates with elevated hemoglobin and ferritin levels, as well as reduced feelings of fatigue, thereby confirming its function as a treatment response rather than a causal risk factor for anemia [25]. As part of this investigation, participants with anemia reported significantly lower frequencies of iron-rich food intake, supporting the role of inadequate dietary iron as a key contributor to anemia. Despite the high proportion of participants in this study reporting regular health checkups, no statistically significant association was observed between routine medical follow-up and anemia status. This finding suggests that anemia may remain undetected or inadequately addressed during routine checkups, highlighting the need for more targeted hematological screening, particularly among adult male patients.

Regarding anemia severity, most anemic patients in this study exhibited mild anemia, while a smaller number were categorised as moderate, and no instances of severe anaemia were found. This distribution aligns with other study findings according to which moderate anemia is the predominant category among adults, particularly in hospital-based study [14]. Furthermore, a longitudinal study indicated that even mild anemia correlates with adverse health impacts, including a higher long-term risk of mortality, highlighting its clinical significance despite its classification as less severe [26].

Iron deficiency significantly contributed to the anemia seen in this cohort, with morphological study indicating microcytic hypochromic anemia as the predominant form. Investigations into iron revealed that several subjects had diminished blood iron levels and decreased iron reserves. Comparable results have been documented in prior research. A retrospective investigation indicated that micronutrient deficiencies, especially iron deficiency, were significantly correlated with anemia and systemic inflammation [27]. Anemia resulting from chronic illness and several other etiologies is a significant factor, as is the occurrence of normocytic normochromic anemia in multiple instances.

This study has several limitations that should be acknowledged. First, because the study was conducted in a hospital-based population, the findings may not be fully generalizable to the broader community. Second, the cross-sectional design limits the ability to establish causal relationships between anemia and the associated factors identified. Additionally, some variables were collected through self-reported questionnaires, which may be subject to recall or reporting bias. The statistical analysis was primarily based on descriptive and comparative methods, and potential confounding variables were not controlled through multivariate analysis. Furthermore, multiple testing corrections were not applied, which may increase the risk of type I error when interpreting statistical associations. Despite these limitations, the study provides valuable insights into the prevalence and associated factors of anemia among adult males and highlights the need for targeted screening and preventive strategies.

CONCLUSIONS

Anemia is an important medical concern among adult male patients in a Security Forces Hospital, with a higher prevalence discovered in the elderly population. Iron deficiency appeared to be a significant contributing factor; nonetheless, the results indicate that anemia in this group appears to be multifaceted in origin. The remarkable correlations seen between anemia and age, physical inactivity, and iron-related factors underscore the importance of improved clinical awareness and regular screening, especially among high-risk populations. Considering the possible effects of anemia on functional ability and overall health, it is essential to implement focused preventative strategies and early diagnostic procedures in hospital and military healthcare environments, as well as among adult males, to enhance early detection and appropriate management.

ABBREVIATIONS

EDTA – ethylenediaminetetraacetic acid

Hb – Hemoglobin

IRB – Institutional review board

MCH – Mean corpuscular hemoglobin

MCHC – Mean corpuscular hemoglobin concentration

MCV – Mean corpuscular volume

RBC – Red blood cell

RDW – Red cell distribution width

WHO – World Health Organization

TIBC – Total iron-binding capacity

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AUTHORS' CONTRIBUTION

R.Z: conceptualization, formal analysis, data management, visualization, writing (original draf).

R.B: investigation, data management, writing (original draft)

T.B: investigation, data management, writing (original draft)

M.A: project administration, writing (review and editing).

All authors have read and approved the final version of the manuscript.

CONFLICT OF INTEREST

None to declare.

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