

Beyond Iron: Dietary, Lifestyle, and Sleep Associated Factors of Anemia in Adults: Evidence from Ranya City, Iraq

Hero Salah Babakir; *Department of Nursing, College of Nursing, University of Raparin, Ranya, Sulaymaniyah, Kurdistan Region, Iraq.* (Correspondence: herosalah19@gmail.com)

Renas Mohamed Khdir; *Department of Nursing, College of Nursing, University of Raparin, Ranya, Sulaymaniyah, Kurdistan Region, Iraq.*

ABSTRACT

Background and Objectives: Anemia, a common blood disorder of low hemoglobin, is a significant global public health issue. While traditionally linked to iron deficiency, recent studies suggest that lifestyle, dietary, and behavioral factors may also play important roles. In Iraq—and specifically Ranya District—there is limited data on how these broader factors contribute to adult anemia. To assess the prevalence of anemia and explore its sociodemographic, dietary, lifestyle, and sleep-associated factors among adults in Ranya District, Iraq.

Methods: A cross-sectional, community-based study was conducted among 384 adults in Ranya City by structured questionnaire administration and laboratory testing of hemoglobin levels. Descriptive statistics and chi-square tests to identify the association between anemia status and explanatory factors.

Results: The overall prevalence of anemia was approximately 24%, with a significantly higher rate among females (31.5%) compared to males (2.9%). Significant associations were found between anemia and gender, occupation, marital status, smoking, dietary patterns, supplement use, meal skipping, and sleep disturbances. Red meat and vegetable intake were not significantly associated. Sleep quality showed a strong relationship with anemia.

Conclusion: Anemia in adults from Ranya City is influenced not only by iron intake but also by modifiable lifestyle and behavioral factors, particularly sleep quality and meal patterns. Public health strategies should expand beyond iron supplementation to address these broader associated factors.

Keywords: Anemia; Dietary habit; Lifestyle Characteristics; Sleep associated factors; Adult population

Received: 09/07/2025

Accepted: 03/09/2025

Published: 30/05/2026

INTRODUCTION

About one-third of the world's population suffers from anemia, a state described by a decreased hemoglobin (Hb) concentration and/or red blood cell (RBC) count below normal levels and not adequate to cover their physiological needs [1]. Anemia contributes to substantial health and socioeconomic burdens, including increased maternal and child mortality, fatigue, cognitive decline, and reduced work capacity [2], [3]. Anemia remains a major global public health problem in adults. The World Health Organization's updated 2024 guideline recommends haemoglobin cutoffs that vary by age, sex, altitude, smoking status, and physiological state, reflecting the need for more accurate diagnosis in individuals and populations. Globally, anemia remains highly prevalent, with an estimated 1.92 billion cases across all ages in 2021. In adults, anemia is clinically important because it can reduce physical capacity, impair cognition, worsen quality of life, and lower work productivity [4]. In adults, the causes of anemia are often multifactorial. Iron deficiency is common, but chronic inflammatory conditions, chronic kidney disease, diabetes, gastrointestinal disorders, occult blood loss, inherited hemoglobinopathies, and deficiencies of folate and vitamin B12 are also important contributors. Recent adult-focused literature emphasizes that anemia should be viewed not only as a nutritional problem but also as a marker of broader medical and social risk [5]. Modifiable lifestyle factors may also influence adult anemia, beyond the underlying disease. Dietary quality, meal timing, smoking, and sleep disturbance have all been investigated as possible contributors to anemia risk in adults. Recent studies among adults have reported associations between anemia and sleep disturbance, as well as anemia-related symptoms that interfere with daily functioning. Despite

increasing recognition of these broader determinants, fewer studies have examined anemia comprehensively in general adult populations using dietary, lifestyle, and sleep-related measures together. Therefore, this study aimed to determine the prevalence of anemia and examine its associated sociodemographic, dietary, lifestyle, and sleep-related factors among adults in Ranya District, Iraq [1, 6].

METHOD

This study used a cross-sectional design to determine the prevalence of anemia and its associated factors among adults in Ranya District, Iraq. The study was conducted in several healthcare settings, including Ranya General Hospital Laboratory, Ranya Central Laboratory, selected primary health care center laboratories, and a private clinic laboratory in Ranya District. These sites were chosen to recruit adults attending laboratory services from different public and private settings. The study population included adults aged 18–60 years who attended the selected laboratories for complete blood count (CBC) testing during the data collection period. The sample size was calculated using the single-population proportion formula with an assumed prevalence of 50%, a 95% confidence level, and a 5% margin of error, yielding a minimum sample size of 384 participants. A total of 420 eligible adults were approached, and 384 agreed to participate. Consecutive sampling was used until the required sample size was reached. Pregnant women, individuals outside the age range, and participants with known inherited hemoglobin disorders were excluded. Data were collected using a researcher-administered structured questionnaire in Kurdish, together with face-to-face interviews, anthropometric measurements, and laboratory assessment.

The questionnaire covered sociodemographic characteristics, clinical information, dietary patterns, eating habits, supplement use, and sleep-related factors. Height and weight were measured using calibrated instruments. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2). BMI categories were defined as follows: underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obese (≥ 30.0). Hemoglobin and other CBC parameters were obtained from recent laboratory results or from venous blood samples collected during the study period and analyzed in accredited laboratories using automated hematology analyzers with routine quality control. The questionnaire was reviewed by experts for content validity and pretested on a small group of adults from the target population. A pilot study was conducted before the main data collection, and the final version of the tool was revised accordingly. Internal consistency was assessed using Cronbach's alpha, and acceptable reliability was obtained for the relevant sections. To ensure data quality, questionnaires were checked daily for completeness and consistency, and data were coded and stored securely. Data were analyzed using SPSS version 27. Descriptive statistics were used to summarize participant characteristics, and chi-square tests were applied to examine associations between anemia status and categorical independent variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows socio-demographic and medical data. The most of respondents (61.5%) were aged 20–39, 32.8% were ≥ 40 years, and only 5.7% were ≤ 19 years. Two-thirds of the respondents were females

(66.9%) and one-third males (33.1%). Most had primary or secondary education, 27.3% had college degrees, and only 0.3% were postgraduate. The most frequent occupational group was housewives (39.1%), followed by government employees (22.7%) and non-government employees (17.7%), with 11.2% students and 9.4% unemployed. Most participants were married (73.7%). Regarding lifestyle factors, 85.4% had no regular exercise (≥ 30 min/day, 5 days/week), with only 14.6% exercising regularly. Smoking was not common: 13.0% were current smokers, 22.9% were secondhand smokers, 1.6% were ex-smokers, and 62.5% were never-smokers. Almost all (97.1%) negated alcohol use. Most of the participants in this study (87.5%) reported a normal body mass index (BMI) of 18.5–24.9, reflecting general healthy weight status for the population. A percentage were overweight (9.4%), while only 2.1% were underweight (BMI <18.5), and 1.0% were obese (BMI ≥ 30). This reflects that most adults in the sample are of normal weight, with relatively low undernutrition or obesity levels. About one-third (34.1%) reported a positive family history of anemia (genetic predisposition). Hematological tests (Table 2) revealed that 21.1% of women participants were anemic (mild to severe) and 45.8% normal (≥ 12 g/dL). Specifically, among women, 0.3% were severely anemic (<8 g/dL), 9.9% moderately anemic (8–10.9), and 10.9% mildly anemic (11–11.9). Among men, 0.8% were moderately anemic (8–10.9 g/dL), 2.1% mildly anemic (11–12.9), and 30.2% normal (≥ 13 g/dL). Figure 1 illustrates the prevalence of anemia in the samples. Overall, roughly 24.0% of participants were anemic (mild to severe) and 76% of participants were non anemic.

Table (1) : Sociodemographic and Lifestyle Characteristics of Adult Participants

Variables		Frequency	Percent
Age	= 18	10	(2.6)
	19 - 28	109	(28.4)
	29 - 39	116	(30.2)
	40 - 49	107	(27.9)
	50-60	42	(10.9)
Gender	Male	127	(33.1)
	Female	257	(66.9)
Education Level	Read and Write	42	(10.9)
	Primary school	119	(31.0)
	Secondary school	117	(30.5)
	Graduated from institute and college	105	(27.3)
	Post graduate	1	(0.3)
Occupation	Student	43	(11.2)
	Governmental employed	87	(22.7)
	Non-governmental employed	68	(17.7)
	Unemployed	36	(9.4)
	Housewife	150	(39.1)
Marital Status	Married	283	(73.7)
	Unmarried	101	(26.3)
Household Income	Sufficient	133	(34.6)
	Barely sufficient	228	(59.4)
	Insufficient	23	(6.0)
Residence	Urban	14	(3.6)
	Rural	246	(64.1)
	Suburban	124	(32.3)
Do you do regular exercise at least (30 minute) for 5 days per week?	Yes	56	(14.6)
	No	328	(85.4)
Smoking Habits	Current smoker	50	(13.0)
	Secondhand Smoke	88	(22.9)
	EX-Smoker	6	(1.6)
	Non-Smoker	240	(62.5)
Alcohol Consumption	Yes	11	(2.9)
	No	373	(97.1)
BMI	< 18.5	8	(2.1)
	18.5–24.9	336	(87.5)
	25 - 29.9	36	(9.4)
	≥ 30	4	(1.0)
Genetic (Family history of anemia)	Yes	131	(34.1)
	No	253	(65.9)

Table (2): Hemoglobin Levels and Anemia Classification Among Participants

Variables		Frequency	Percent
Hb (Female)	Severe(<8g/dl)	1	(0.3)
	Moderate(8-10.9g/dl)	38	(9.9)
	Mild(11-11.9g/dl)	42	(10.9)
	Normal (≥12)	176	(45.8)
Hb (Male)	Moderate(8-10.9g/dl)	3	(0.8)
	Mild(11-12.9g/dl)	8	(2.1)
	Normal(≥13g/dl)	116	(30.2)

Table 3 presents the frequency of consumption of key protein and dairy foods among participants. Red meat consumption was generally low, with 34.1% of participants consuming it once per month and 31.0% consuming it 1–2 times per week, while 13.0% reported never consuming red meat. In contrast, poultry consumption was higher, with 19.8% of participants consuming it daily and only 3.9% reporting no consumption.

Fish intake was relatively infrequent, as more than half of participants (50.5%) consumed fish monthly, and only 0.8% reported daily consumption. Egg consumption was more common, with 30.5% consuming eggs daily, although 20.6% reported never consuming them. Dairy products were the most frequently consumed food group, with 70.8% of participants reporting daily consumption and only 9.4% reporting no intake.

Table 3. Frequency of Animal-Based Protein and Dairy Consumption

Variables		Frequency	Percent
Red Meat (beef, lamb, calf, and goat)	Never	50	(13)
	Monthly	131	(34.1)
	1-2 times/week	119	(31)
	2-3 times/week	44	(11.5)
	4-6 times/week	26	(6.8)
	Daily	14	(3.6)
Poultry (chicken, turkey)	Never	15	(3.9)
	Monthly	12	(3.1)
	1-2 times/week	70	(18.2)
	2-3 times/week	114	(29.7)
	4-6 times/week	97	(25.3)
	Daily	76	(19.8)
Fish	Never	79	(20.6)
	Monthly	194	(50.5)
	1-2 times/week	81	(21.1)
	2-3 times/week	20	(5.2)
	4-6 times/week	7	(1.8)
	Daily	3	(0.8)
Egg	Never	79	(20.6)
	Monthly	35	(9.1)
	1-2 times/week	68	(17.7)
	2-3 times/week	58	(15.1)
	4-6 times/week	27	(7)
	Daily	117	(30.5)
Dairy Product	Never	36	(9.38)
	Monthly	13	(3.39)
	1-2 times/week	33	(8.59)
	2-3 times/week	18	(4.69)
	4-6 times/week	12	(3.13)
	Daily	272	(70.83)

Table 4 shows that fruit and vegetable intake was generally high among participants. 58.3% of participants reported consuming fruits daily, while only 7.3%

reported never consuming them. Similarly, 59.4% of participants reported daily vegetable intake, and 10.4% reported no consumption.

Table 4. Frequency of Fruit and Vegetable Consumption

Variables		Frequency	Percent
Fruits (citrus fruits, berries, apples, bananas, etc.)	Never	28	(7.3)
	Monthly	15	(3.9)
	1-2 times/week	56	(14.6)
	2-3 times/week	33	(8.6)
	4-6 times/week	28	(7.3)
	Daily	224	(58.3)
Vegetables	Never	40	(10.4)
	Monthly	9	(2.3)
	1-2 times/week	42	(10.9)
	2-3 times/week	41	(10.7)
	4-6 times/week	24	(6.3)
	Daily	228	(59.4)

Table 5 presents the frequency of consumption of legumes, grains, seeds, and nuts. More than half of participants (58.3%) consumed beans, lentils, or chickpeas 1–2 times per week, while 8.3% reported never consuming them. Whole grains were also commonly consumed on a weekly basis, with 52.9% reporting intake 1–2 times per week; however, 20.8% reported no consumption, and only 4.7% consumed them daily. Refined grains were consumed daily by the majority of participants (84.6%), indicating their role as a dietary staple. Seed consumption was moderate, with 20.6% reporting no intake and 10.9% consuming them daily. Nut consumption varied, with 24.2% consuming nuts daily and 6.5% reporting no consumption. Table 6 summarizes beverage consumption patterns. Tea was the most commonly consumed beverage, with 84.5% of participants reporting daily intake and only 7.5% reporting no consumption. Coffee consumption was less common, with 24.3% consuming it daily and 45.5% reporting no intake. Energy drink consumption was rare: 81.8% of participants reported never consuming them, and only 5.7% consumed them daily. Similarly, carbonated drinks were not widely

consumed, with 53.0% reporting no intake and 13.5% consuming them daily. Table 7 presents general eating habits among participants. Only 13.0% reported following a medically prescribed special diet. Regular meal consumption was reported by 62.5% of participants, while 37.5% did not follow regular meal patterns. Approximately half of participants (49.2%) reported drinking at least eight glasses of water per day. More than half (56.3%) reported consuming tea or coffee immediately after meals. Consumption of unhealthy snacks such as fast food and sweets was generally low, with 44.0% reporting no consumption and only 7.6% consuming them daily. Regarding eating speed, 49.7% described their eating speed as moderate, 28.6% as fast, and 21.6% as slow. Skipping breakfast was relatively common, with 35.4% reporting frequent skipping, while lunch and dinner were rarely skipped, with 85.4% and 91.6% reporting no skipping, respectively. Table 8 shows the frequency of supplement use among participants. The majority reported no use of iron (57.8%), folic acid (71.9%), vitamin B₁₂ (76.8%), or multivitamin supplements (57.0%). Daily use of these supplements was reported by only a small proportion of participants.

Table 5: Consumption of Grains, Seeds, and Nuts Among Participants

Variables		Frequency	Percent
Beans, lentils, chickpeas	Never	32	(8.3)
	Monthly	27	(7)
	1-2 times/week	224	(58.3)
	2-3 times/week	65	(16.9)
	4-6 times/week	16	(4.2)
	Daily	20	(5.2)
Whole grains (brown rice, whole wheat bread, oats)	Never	80	(20.8)
	Monthly	46	(12)
	1-2 times/week	203	(52.9)
	2-3 times/week	28	(7.3)
	4-6 times/week	9	(2.3)
	Daily	18	(4.7)
Refined grains (white rice, white bread)	Never	10	(2.6)
	Monthly	1	(0.3)
	1-2 times/week	7	(1.8)
	2-3 times/week	15	(3.9)
	4-6 times/week	26	(6.8)
	Daily	325	(84.6)
Seeds	Never	79	(20.6)
	Monthly	40	(10.4)
	1-2 times/week	97	(25.3)
	2-3 times/week	91	(23.7)
	4-6 times/week	35	(9.1)
	Daily	42	(10.9)
Nuts	Never	25	(6.5)
	Monthly	29	(7.6)
	1-2 times/week	74	(19.3)
	2-3 times/week	95	(24.7)
	4-6 times/week	68	(17.7)
	Daily	93	(24.2)

Table 6: Beverage Consumption Patterns, Including Iron Absorption Inhibitors

Variables		Frequency	Percent
Tea	Daily	338	(84.5)
	4-6 times/week	7	(1.75)
	2-3 times/week	6	(1.5)
	1-2 times'/week	14	(3.5)
	Monthly	5	(1.25)
	Never	30	(7.5)
Coffee	Daily	97	(24.25)
	4-6 times/week	12	(3)
	2-3 times/week	21	(5.25)
	1-2 times'/week	56	(14)
	Monthly	32	(8)
	Never	182	(45.5)
Energy drinks	Daily	23	(5.75)
	4-6 times/week	3	(0.75)
	2-3 times/week	4	(1)
	1-2 times'/week	22	(5.5)
	Monthly	21	(5.25)
	Never	327	(81.75)
Soda and fizzy drinks	Daily	54	(13.5)
	4-6 times/week	10	(2.5)
	2-3 times/week	25	(6.25)
	1-2 times'/week	63	(15.75)
	Monthly	36	(9)
	Never	212	(53)

Table 7. General Eating Habits and Meal Timing Patterns

Variables		Frequency	Percent
Having any special system in eating under the physician order?	Yes	50	(13)
	No	334	(87)
Do you eat regular meals (at time)?	Yes	240	(62.5)
	No	144	(37.5)
Do you drink at least 8 glasses (about 2 liters) of water per day?	Yes	189	(49.2)
	No	195	(50.8)
Do you often consume tea or coffee directly after meals?	Yes	216	(56.3)
	No	168	(43.8)
	Never	169	(44)
	Monthly	19	(4.9)
Unhealthy snacks (Chips, Candy, Soda, Fast food)	1-2 times/week	75	(19.5)
	2-3 times/week	69	(18)
	4-6 times/week	23	(6)
	Daily	29	(7.6)
How is your eating pattern?	Slowly	83	(21.6)
	Moderate	191	(49.7)
	Quickly	110	(28.6)
	Often	136	(35.4)
How often do you skip breakfast?	Sometimes	33	(8.6)
	Rarely	6	(1.6)
	Never	209	(54.4)
	Often	23	(6)
How often do you skip lunch?	Sometimes	24	(6.3)
	Rarely	9	(2.3)
	Never	328	(85.4)
	Often	6	(1.6)
How often do you skip dinner?	Sometimes	26	(6.8)
	Rarely	11	(2.9)
	Never	341	(88.8)
	Often	6	(1.6)

Table 8. Frequency of Iron, Folate, B12, and Multivitamin Supplement Use

Variables		Frequency	Percent
How often do you take iron supplements?	Never	222	(57.8)
	Very irregularly	127	(33.1)
	1-2 times/week	10	(2.6)
	3-5 times/week	3	(0.8)
	Daily	22	(5.7)
How often do you take folic acid?	Never	276	(71.9)
	Very irregularly	87	(22.7)
	1-2 times/week	3	(0.8)
	3-5 times/week	1	(0.3)
How often do you take vitamin B12?	Daily	17	(4.4)
	Never	295	(76.8)
	Very irregularly	63	(16.4)
	1-2 times/week	8	(2.1)
How often do you take multivitamins?	3-5 times/week	2	(0.5)
	Daily	16	(4.2)
	Never	219	(57)
	Very irregularly	120	(31.3)
How often do you take multivitamins?	1-2 times/week	8	(2.1)
	3-5 times/week	5	(1.3)
	Daily	32	(8.3)

Table 9 presents sleep-related characteristics of participants. Nearly half (46.4%) reported regularly sleeping 6–8 hours per night, while others reported this duration only sometimes or rarely. Difficulty falling asleep was not reported by 39.3% of participants, while the remaining participants experienced this issue occasionally or frequently. Table 10 shows the association of sociodemographic, anthropometric, genetic, and lifestyle factors with anemia. The distribution of anemic and non-anemic participants across various sociodemographic characteristics. Prevalence of anemia significantly differs based on gender, occupation, family history, and symptom intensity. Females have a higher percentage of anemic subjects (21.1%) than males (2.9%), and only 2.1% of anemic individuals are students. Occupational status is also significantly impacted, with 9.1% of non-anemic subjects being students. A positive genetic history is associated with anemia status, with 22.1% of non-anemic subjects

having a relevant genetic factor compared to 12.0% of anemic subjects. Smoking habits only showed a statistically significant association with anemia ($\chi^2=14.920$, $p=0.000$). For example, active smokers constituted 12.2% of the non-anemic group but only 0.8% of the anemic group, whereas non-smokers constituted 44.0% of the non-anemic and 18.5% of the anemic group. In comparison, regular physical exercise (30-minute sessions ≥ 5 days/week) as well as the consumption of alcohol did not show significant differences in anemia prevalence (both $p>0.05$), as their p-values equaled 0.070 and 0.060, respectively. Table 11 shows a comparison of anemia prevalence by frequency of consumption of several food groups. The results show that anemia status significantly differed by consumption of certain nutrient-rich foods. A strong association between poultry consumption and anemia, for example, was established ($\chi^2=35.453$, $p=0.001$): much lower proportions of

anemic adults compared to non-anemic adults were found to consume poultry every day. Other primary differences were fruits ($\chi^2=12.643$, $p=0.027$), dairy ($\chi^2=19.351$, $p=0.002$), beans/lentils/chickpeas ($\chi^2=14.188$, $p=0.014$), whole grains ($\chi^2=29.834$, $p=0.000$), and nuts ($\chi^2=11.341$, $p=0.045$). In all of them, higher consumption was related to lower anemia percent (i.e, non-anemic subjects had a greater chance of consuming these foods frequently). In contrast, the frequency of red meat, fish, egg, vegetable, refined grain, and seed consumption did not differ by anemia status (all $p>0.05$). Table 12 compares anemia prevalence across frequencies of beverage consumption. The only statistical association was with coffee consumption ($\chi^2=11.435$, $p=0.043$). Specifically, a significantly higher proportion of non-anemic adults had never used coffee compared with anemic adults – for example, 33.6% of non-anemic adults had never used coffee versus 11.7% of anemic adults ($\chi^2=11.435$, $p=0.043$). No significant differences appeared in tea, energy drinks, or soda (all $p>0.05$). Table 13 presents the anemia prevalence in relation to various meal-related habits and drinking behaviors. Only normal meal timing among the variables being examined had a statistically significant correlation with anemia status ($\chi^2 = 5.504$, $p = 0.019$). Specifically, regular meal consumption was reported by 45.1% of non-anemic patients, whereas only 17.4% of anemic patients reported the same. On the contrary, 31.0% of the non-anemic patients and just 6.5% of the anemic patients had not consumed meals at regular times. This suggests that having regular meal times may be associated with a lower prevalence of anemia. Other variables—such as following a special physician-recommended diet system ($\chi^2 = 2.041$, $p = 0.153$) and having tea or coffee right after meals ($\chi^2 = 0.614$, $p = 0.433$)—did not show

statistically significant differences between anemic and non-anemic individuals. Table 14 presents meal-taking behaviors, snacking, supplement ingestion, and sleep quality with anemia. Repeated intake of unhealthy snacks (chips, candies, and fast food) was also associated with anemia ($\chi^2=15.301$, $p=0.009$), and there was a greater percentage of anemia among snack consumers. The most significant impacts were from missing meals. Anemic participants are missing meals more often. Other variables (special diets, fluid intake, tea/coffee after meals, and eating speed) had no significant differences. All of the groups of supplements were significantly associated: non-anemic adults were significantly more likely to consume iron, folic acid, vitamin B12, or multivitamins than anemic adults. In contrast, sleep duration (6–8 hours) was not different by anemia, but anemia had a significant correlation with sleep quality: difficulty in falling asleep ($\chi^2=17.839$, $p=0.000$), waking up at night ($\chi^2=24.566$, $p=0.000$), and waking up too early ($\chi^2=25.280$, $p=0.000$) were all more common among anemic subjects.

Table 9. Self-Reported Sleep Patterns and Sleep Disturbances

Variables		Frequency	Percent
How often do you sleep 6-8 hours per night?	Never	23	(6)
	Rarely	61	(15.9)
	Sometimes	122	(31.8)
	Often	178	(46.4)
Difficulty Falling Asleep	Never	151	(39.3)
	Rarely	12	(3.1)
	Sometimes	86	(22.4)
	Often	135	(35.2)
	Never	168	(43.8)
	How often do you wake up during the night?	Rarely	7
Sometimes		106	(27.6)
Often		103	(26.8)
How often do you wake up too early in the morning?	Never	110	(28.6)
	Rarely	14	(3.6)
	Sometimes	92	(24)
	Often	168	(43.8)

Table 10. Chi-Square Associations Between Sociodemographic and Lifestyle Factors and Anemia

Variables	Category	Anemia		(X ²)	P-Value
		No	Yes		
Age	= 18	2	1	3.821	0.43
	19 - 28	23	5		
	29 - 39	23	7		
	40 - 49	20	8		
	50-60	8	3		
Gender	Male	30.2	2.9	24.373	< 0.001
	Female	45.8	21.1		
	Illiterate	8.3	2.6		
Education Level	Primary school	23.2	7.8	0.649	0.96
	Secondary school	23.7	6.8		
	Graduated from institute and college	20.6	6.8		
	Post graduate	0.3	0.0		
	Student	9.1	2.1		
Occupation	Governmental employed	19.5	3.1	43.815	< 0.001
	Non-governmental employed	16.1	1.6		
	Unemployed	3.6	5.7		
	Housewife	27.6	11.5		
Marital Status	Married	54.2	19.5	3.821	0.05
	Unmarried	21.9	4.4		
Household Income	Sufficient	25.0	9.6	3.967	0.14
	Barely sufficient	47.1	12.2		
	Insufficient	3.9	2.1		
Residence	Urban	2.3	1.3	1.15	0.56
	Rural	49.2	14.8		
	Suburban	24.5	7.8		
BMI	< 18.5	1.3	0.8	4.22	0.24
	18.5–24.9	68.0	19.5		
	25 - 29.9	6.0	3.4		
Genetic	≥ 30	0.8	0.3	13.583	< 0.001
	Yes	22.1	12.0		
Do you do regular exercise for at least 30 minutes for 5 days per week?	No	53.9	12.0	3.367	0.07
	Yes	12.5	2.1		
Smoking Habits	Current smoker	12.2	0.8	14.92	< 0.001
	Secondhand Smoke	18.8	4.2		
	EX-Smoker	1.0	0.5		
	Non-Smoker	44.0	18.5		
Alcohol Consumption	Yes	2.9	0.0	3.568	0.06
	No	73.2	24.0		

Table 11. Association Between Food Group Frequency and Anemia Status

Variables	Have Anemia? (%)	Frequency of Consumption						(X ²)	P-Value
		Never	1/Month	1-2 times/week	2-3 times/week	4-6 times/week	Daily		
Red Meat	No,	10.7	23.7	23.4	8.9	6.0	3.4	8.506	0.130
	Yes	2.3	10.4	7.6	2.6	0.8	0.3		
Poultry	No	1.6	1.3	12.5	21.1	22.1	17.4	35.453	< 0.001
	Yes	2.3	1.8	5.7	8.6	3.1	2.3		
Fish	No	14.6	38.5	16.1	4.4	1.6	0.8	3.356	0.645
	Yes	6.0	12.0	4.9	0.8	0.3	0.0		
Egg	No	16.7	6.5	12.8	10.9	4.7	24.5	4.982	0.418
	Yes	3.9	2.6	4.9	4.2	2.3	6.0		
Fruits	No	5.7	3.6	11.5	5.7	3.9	45.6	12.643	0.027
	Yes	1.6	0.3	3.1	2.9	3.4	12.8		
Vegetables	No	7.8	2.1	8.3	7.6	3.6	46.6	6.367	0.272
	Yes	2.6	0.3	2.6	3.1	2.6	12.8		
Dairy Product	No	7.3	2.1	6.5	1.8	1.8	56.5	19.351	0.002
	Yes	2.1	1.3	2.1	2.9	1.3	14.3		
Beans, lentils, chickpeas	No	6.3	5.7	47.1	11.2	3.1	2.6	14.188	0.014
	Yes	2.1	1.3	11.2	5.7	1.0	2.6		
Whole grains	No	15.1	9.6	43.5	4.9	1.6	1.3	29.834	< 0.001
	Yes	5.7	2.3	9.4	2.3	0.8	3.4		
Refined grains	No	1.8	0.3	1.0	3.1	3.9	65.9	7.403	0.192
	Yes	0.8	0.0	0.8	0.8	2.9	18.8		
Seeds	No	15.1	6.5	19.5	18.5	7.6	8.9	6.056	0.301
	Yes	5.5	3.9	5.7	5.2	1.6	2.1		
Nuts	No	4.2	4.7	13.3	19.3	14.3	20.3	11.341	0.045
	Yes	2.3	2.9	6.0	5.5	3.4	3.9		

Table 12. Association Between Beverage Consumption and Anemia Status

Variables	Have Anemia? (%)	Frequency of Consumption						(X ²)	P-Value
		Daily	4-6 times/week	2-3 times/week	1-2 times/week	1/Month	Never		
Tea	No	65.6	1.0	0.8	1.8	1.0	5.7	6.341	0.274
	Yes	19.5	0.8	0.8	1.3	0.3	1.3		
Coffee	No	20.1	1.8	3.9	11.5	5.2	33.6	11.435	0.043
	Yes	3.1	1.3	1.6	3.1	3.1	11.7		
Energy drinks	No	5.2	0.3	0.8	4.2	3.6	62.0	6.209	0.286
	Yes	0.5	0.5	0.3	1.6	1.6	19.5		
Soda and fizzy drinks	No	10.9	1.6	4.9	12.5	5.5	40.6	7.092	0.214
	Yes	2.1	1.0	1.6	3.6	3.4	12.2		

Table 13. Associations of Meal Patterns with Anemia

Variables	Category	Anemia		(X ²)	P-Value
		No, (%)	Yes, (%)		
Having any special system in eating under the physician order?	Yes	8.9	4.2	2.041	0.153
	No	67.2	19.8		
Do you eat regular meals (at time)?	Yes	45.1	17.4	5.504	0.019
	No	31.0	6.5		
Do you often consume tea or coffee directly after meals?	Yes	41.9	14.3	0.614	0.433
	No	34.1	9.6		

Table 14. Meal Regularity, Snacks, Supplement Use, Sleep Quality and Association with Anemia

Variables	Have Anemia? (%)	Frequency of Consumption						(X ²)	P-Value
		Never	1/Month	1-2 times/ week	2-3 times/ week	4-6 times/ week	Daily		
Unhealthy snacks (Chips, Candy, Soda, Fast food)	No,	35.4	2.1	15.4	12.8	4.4	6.0	15.301	0.009
	Yes	8.6	2.9	4.2	5.2	1.6	1.6		
How is your eating pattern?	No		Slowly 17.4		Moderate 35.4		Quickly 23.2	4.882	0.087
	Yes		4.2		14.3		5.5		
How often do you skip breakfast?	No		Often 27.3		Sometimes 4.9		Rarely 0.3	19.600	< 0.001
	Yes		8.1		3.6		1.3		
How often do you skip lunch?	No		Often 4.9		Sometimes 3.9		Rarely 0.8	12.493	0.006
	Yes		1.0		2.3		1.6		
How often do you skip dinner?	No		Often 1.3		Sometimes 4.4		Rarely 0.5	23.227	< 0.001
	Yes		0.3		2.3		2.3		
How often do you take iron supplements?	No	Never 48.7	Very irreg- ularly 22.9	1-2 times/ week 1.0	3-5 times/ week 0.0		Daily 3.4	31.477	< 0.001
	Yes	9.1	10.2	1.6	0.8		2.3		
How often do you take folic acid	No	Never 58.6	Very irreg- ularly 14.1	1-2 times/ week 0.5	3-5 times/ week 0.0		Daily 2.9	18.391	0.001
	Yes	13.3	8.6	0.3	0.3		1.6		
How often do you take vitamin B12	No	63.5	9.9	0.5	0.0		2.1	39.498	< 0.001
	Yes	13.3	6.5	1.6	0.5		2.1		
How often do you take multivitamins	No	Never 46.1	Very irreg- ularly 22.9	1-2 times/ week 0.8	3-5 times/ week 0.3		Daily 6.0	18.677	0.001
	Yes	10.9	8.3	1.3	1.0		2.3		
How often do you sleep 6-8 hours per night?	No		Never 4.9		Rarely 13.0		Some- times 24.7	3.611	0.307
	Yes		1.0		2.9		7.0		
Difficulty Falling Asleep	No		Never 33.6		Rarely 1.3		Some- times 16.4	17.839	< 0.001
	Yes		5.7		1.8		6.0		
How often do you wake up during the night?	No		Never 38.5		Rarely 1.3		Some- times 19.0	24.566	< 0.001
	Yes		5.2		0.5		8.6		
How often do you wake up too early in the morning?	No		Never 25.5		Rarely 1.3		Some- times 18.2	25.280	< 0.001
	Yes		3.1		2.3		5.7		

Figure 1 illustrates the prevalence of anemia in the samples. Overall, roughly 24.0% of participants were anemic (mild to severe) and 76% of participants were non anemic.

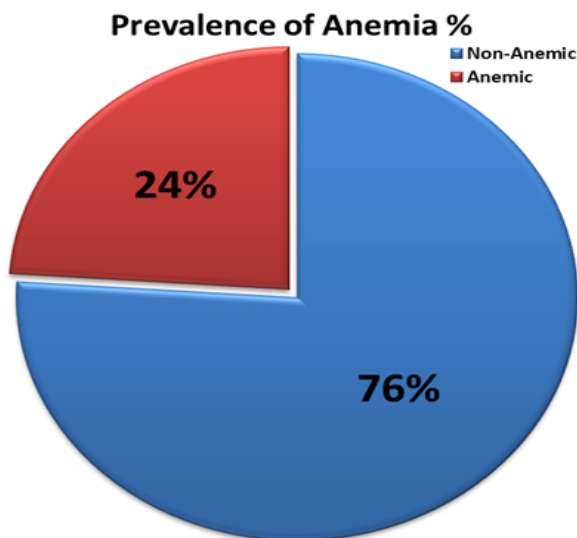


Figure 1. Prevalence of anemia

DISCUSSION

This study aimed to determine the prevalence of anemia and its associated factors in 384 adults in Ranya City. Among the adult population in Ranya, no significant association was found between anemia and major sociodemographic factors, except for occupation and gender. Chi-square analysis did not indicate a significant correlation of anemia with age, level of education, income, or urban or rural residence. This shows that anemia prevalence was relatively uniform in these subgroups. The findings showed that almost 24% of the participants were anemic, and its prevalence was significantly different in females (31.5%) compared to males (8.7%). This gender disparity is consistent with global and regional trends, where women in their reproductive ages are disproportionately affected by anemia due to menstrual blood loss, pregnancy, and lactation [7, 8]. Occupation was also strongly associated: e.g., students and homemakers (groups

comprising mainly women) had more anemia than working adults. In contrast, other variables like exercise regularly and marital status were merely borderline or nonsignificant. Such null findings are consistent with some prior research; e.g., Jalambo et al. discovered no significant connection between anemia and regularity of exercise [9]. Similarly, education and income were not prominent factors in our sample, possibly reflecting relatively homogeneous socioeconomic conditions or suggesting that nutritional anemia in this population is more strongly influenced by dietary and biological determinants than by formal education. Of note, smoking habits were highly correlated with anemia. This at first glance appears counterintuitive, as most research establishes that smokers have higher hemoglobin levels (from carbon monoxide exposure) and thus lower apparent anemia rates. In the current study, the majority of smokers were men (only ~13% of the sample smoked, almost all of whom were men), and men generally had a lower prevalence of anemia. We credit this finding to gender confounding: there were few men who smoked, and they had a higher mean hemoglobin, and were more likely to be non-anemic, and therefore smoking status became associated with anemia status. In short, it is doubtful that smoking protects against anemia; rather, the large χ^2 is due to the gender-related confounding effect [10]. Alcohol use was very rare and did not have a meaningful association [11]. Many studies show that increased BMI was associated with increased hemoglobin levels [12]. In our results, body mass index (BMI) was not significantly related to anemia prevalence, meaning that both underweight and overweight subjects in Ranya City had equal anemia rates. This is consistent with several recent studies. For instance, a large cross-sectional study of adults in Australia did not find a uniform

association between BMI categories and anemia, while there was differential iron and vitamin B₁₂ status across weight [13]. Finally, a positive family history or genetic susceptibility was also significantly linked with anemia status. This is biologically logical in Kurdistan, given that hemoglobinopathies are inherited (especially the β -thalassemia trait) and are relatively prevalent. Thalassemia carriers or carriers of other genetic blood disorders may have low baseline hemoglobin and can be classified as being anemic even when there are normal iron stores. The high prevalence of consanguinity in the area also sharpens such traits. Our finding agrees with established genetic epidemiology: for example, research on Iraqi Kurds reported β -thalassemia carrier rates of ~4–7% among Iraqi Kurds. Taken together, these data suggest that, apart from biological factors (sex, genetics), conventional socio-demographic factors did not play a substantial role in anemia prevalence among this population [14]. Both expected and unexpected associations were observed with dietary factors. The consumption of multiple iron-rich and nutrient-dense food groups demonstrated a strong relationship with anemia status. In particular, frequent poultry consumption, dairy products, fruits, legumes (beans, lentils, and chickpeas), and whole grains were all highly correlated with lower anemia prevalence. This trend agrees with World Health Organization recommendations to "eat iron-rich foods, including lean red meats, fish and poultry, legumes (lentils and beans), fortified cereals, and dark green leafy vegetables" to prevent anemia. For example, our finding on poultry is biologically plausible since chicken and turkey are sources of high-quality heme iron and vitamin B₁₂. The grouping with whole grains and legumes also makes biological sense, as these plant foods are sources of

non-heme iron, folate, and other anemia-preventing nutrients. Additionally, the function of vitamin C-rich fruits may be to enhance iron absorption. Indeed, our findings show fruit intake had a protective effect, again mirroring WHO guidelines to consume fruits and vegetables that enhance iron absorption. Conversely, a few anticipated dietary items failed to show any meaningful effect. Red meat, fish, eggs, green leafy vegetables, refined cereals, and seeds were not significantly associated with anemia. The absence of significance in the case of red meat and eggs is somewhat surprising since these are sources of iron. However, similar null findings have been reported in the literature before. A study from the United Arab Emirates reported no significant relationship between the consumption of red meat or eggs and anemia. Low variability of consumption pattern or compensatory eating habits (for instance, those who do not eat red meat might eat other iron foods) could be responsible for the lack of effect [15]. The role of dietary inhibitors of iron uptake was evident from our observations. Coffee intake but not the intake of tea was strongly associated with anemia. This corresponds to facts that caffeine and polyphenols present in tea and coffee "slow down iron absorption" [16], and should be avoided near meals. Our finding shows that those who had higher intakes of coffee had greater rates of anemia. (Interestingly, tea did not show a significant association in our sample, perhaps due to differences in tea strength, timing, or sample size.). The second major finding was meal-skipping tendencies: participants who regularly skipped breakfast, lunch, or dinner were much more likely to be anemic. Those who reported taking regular meals on time were less anemic. These findings corroborate that poor overall dietary habits are a cause of anemia.

A Pakistani university student's study also found a strong link between anemia and skipping breakfast regularly [17]. Eating meals regularly supplies sufficient iron and other nutrients throughout the day, so skipping meals presumably reduces overall iron intake and increases anemia risk. Vitamin/mineral supplement use was low in general but highly related to anemia status. Daily iron supplement use was reported by just 5.7% of participants, and 4.4% took folic acid daily; 4.2% used B₁₂ supplements daily. As might be expected, the chi-square analyses revealed that the use of any supplement was significantly associated with anemia, as were iron supplements, folic acid, vitamin B₁₂, and multivitamins. At a practical level, anemic individuals were much more likely to report supplementation with these, likely because they had been instructed to do so. Indeed, this association likely reflects treatment-seeking: patients may start iron or vitamin supplements after anemia has been diagnosed. Interestingly, the data indicate that a lack of supplementation played a role in the high rate of anemia. This finding is consistent with other studies conducted in the region. For example, Pirof and Weli found that supplemented pregnant women in Sulaymaniyah had much lower anemia prevalence (34.9%) than un-supplemented women (74.2 %) [18]. These regional findings emphasize that proper iron/folate supplementation, especially for reproductive-age women, would significantly reduce anemia in this group. WHO also emphasizes supplementation: a healthy diet and "taking supplements if a qualified health-care provider recommends them" are the primary preventive steps. The very low supplement uptake we observed points to the necessity for stronger public health messaging and supplement availability. We also measured several lifestyle variables.

Only 14.6% of participants engaged in regular exercise (≥ 5 days/week), and no significant association with anemia was observed, in agreement with other studies reporting no relationship between exercise and anemia [19]. Though average sleep duration (6–8 hours/night) did not differ between anemic and non-anemic groups, several indicators of sleep disturbance were convincingly higher in anemic subjects. Subjects who reported difficulty falling asleep often, waking up during the night, or waking up too early were significantly more likely to have anemia. Briefly, our results indicate that restless or fragmented sleep—rather than hours slept—is related to anemia status. This is plausible biologically. Iron plays a role in the functioning of the central nervous system, and iron deficiency is an established cause of restless legs syndrome (RLS) and periodic limb movements, which can profoundly disrupt sleep [20]. Consistent with this, Semiz et al. found that global sleep quality scores were significantly worse in iron-deficiency anemia patients than in controls, even after controlling for depression or anxiety [21]. In this study, iron deficiency anemia (IDA) patients also had significantly higher Pittsburgh Sleep Quality Index scores, indicating worse sleep. In accordance, our result of more sleep complaints in anemic adults is consistent with these clinical reports. Fatigue and daytime somnolence—anemia symptoms par excellence—can also render restorative sleep elusive, in a vicious cycle. A strong association between sleep disturbances and anemia was identified in our study, in agreement with earlier research [22]. This suggests that health workers in Ranya should be alert to sleep complaints as a possible sign of underlying anemia.

CONCLUSION

The findings of this study indicate that anemia in the Ranya District population is associated with multiple modifiable risk factors. The overall frequency was mild; however, anemia was markedly elevated in females and closely linked to lifestyle behaviors such as inadequate sleep quality, frequent meal skipping, restricted consumption of meals full of nutrients and little consumption of micronutrient supplements. Dietary patterns that included chicken, legumes, dairy, and fruits were associated with a protective effect, whereas coffee intake and interrupted sleep correlated with an increased risk of anemia. Unexpectedly, the consumption of red meat and vegetables did not emerge as significant predictors, suggesting that dietary quality and timing may have more importance than conventional beliefs on iron-rich foods. These results underscore the need for a comprehensive public health strategy, one that not only advocates for iron supplementation but also fosters improved sleep well-being, nutritional education, and behavioral interventions. A comprehensive approach to these issues may provide more effective anemia prevention techniques in Ranya and comparable environments.

Conflict of Interest

No conflict of interest to declare

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