



Prevalence of Anemia and Associated Factors among Pregnant Women attending Al-Sabeen Hospital, Sana'a City, Yemen

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ABSTRACT

Background and objectives: Anemia in pregnancy is a significant public health issue, especially in low-income countries like Yemen. It leads to negative maternal and fetal outcomes, which are shaped by various socioeconomic, obstetric, dietary, and biological factors. This study aimed to assess the prevalence of anemia and its associated factors among pregnant women at the Maternity and Childhood Al-Sabeen Hospital in Sana'a, Yemen.

Methods: The cross-sectional study involving 376 pregnant women at Al-Sabeen Hospital was conducted from October 7 - 2024, to August 30, 2025. Researchers collected sociodemographic data, obstetric history, and dietary habits via a structured questionnaire. Hemoglobin and hematological parameters were evaluated through complete blood count analysis. Data analysis employed SPSS version 25, utilizing descriptive statistics, bivariate, and multivariable logistic regression to identify factors independently associated with anemia, with statistical significance set at $p < 0.05$.

Results: The overall prevalence of anemia was 27.9%, indicating a moderate public health problem. Most anemic cases were mild (16.0%) and moderate (11.7%), while severe anemia was rare (0.3%). Multivariable logistic regression analysis showed that maternal age 18–24 years (AOR = 1.91), large family size (>8 members) (AOR = 2.79), grand multiparity (AOR = 2.97), and short interpregnancy interval (≤ 2 years) (AOR = 2.21) were significantly associated with higher odds of anemia. Higher monthly income (71,000–90,000 YR) was protective (AOR = 0.33). Dietary habits revealed a strong association between infrequent meat consumption and anemia, with women who never consumed meat having markedly higher odds (AOR = 11.85). Hemoglobin levels were positively associated with RBC indices and negatively associated with RDW and inflammatory markers.

Conclusion: Anemia among pregnant women attending Al-Sabeen Hospital remains a moderate public health problem, predominantly of mild to moderate severity. Young maternal age, low socioeconomic status, high parity, short birth spacing, large family size, and inadequate meat consumption were key determinants. By identifying specific risk factors like low iron intake, rural residency, and low visit frequency, the findings guide targeted public health interventions to protect mothers and babies.

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1. INTRODUCTION

Anemia is a serious global public health problem that particularly affects young children, menstruating adolescent girls and women, and pregnant and postpartum women [1]. Anemia is a medical condition characterized by a lower in blood hemoglobin (Hb) level or the number of erythrocytes (RBCs) or defect in maturation of erythrocytes. Anemia affects all age groups but is more prevailing in pregnant women and children [2]. Anemia in pregnancy is defined as Hb less than 11 g/dL or in number of RBCs, resulting in diminished oxygen-carrying capacity of red blood cells to bodily tissues [3]. The severity of anemia is categorized into: mild (Hb 10.0–10.9 g/dL), moderate (Hb 7.0–9.9 g/dL), and severe (Hb < 7.0 g/dL) [3]. According to the World Health Organization (WHO), Anemia is classified as severe when the prevalence is greater than 40%, moderate if it falls between 20% and 40%, and mild if it falls between 5% and 20% [4].

According to a report by the WHO, the occurrence of anemia in pregnant females is documented at 41.8%, notably peaking at 61.3% in Africa and 52.5% in the South East Asia region [1]. The global prevalence of anemia in 2019 is 36.5% in pregnant women, 29.9% in women of reproductive age, which equates to over half a billion women aged 15–49 years, and 29.6% in non-pregnant women of reproductive age [3]. In Yemen, in 2019, according to the WHO global health observatory, the prevalence of anemia in pregnancy is 57.5%. In 2011, the prevalence is 36% [3]. Moreover, previous studies have shown that the prevalence of anemia among pregnant women in Yemen varies between 26.5% and 81% [5, 6].

The causes of anemia in pregnancy have a multifactorial etiology. It can stem from various causes, such as nutritional deficiencies (iron, folic acid, and vitamin B12), genetic factors (thalassemia and sickle cell), autoimmune conditions (hemolytic anemia), malabsorption issues (achlorhydria), and chronic illnesses (such as cancer) [7]. The common cause of anemia during pregnancy is iron deficiency, particularly in low- and middle-income countries. Approximately 50% of anemia cases among women and girls are due to iron deficiency, which is a consequence of malnutrition, poverty, and periodic blood loss during menstruation [8].

Anemia during pregnancy has adverse effects on both mothers and babies. It includes an increased risk of hemorrhage, sepsis, maternal mortality, perinatal mortality, low birth weight, and decreased work capacity [4]. The risk of death among pregnant women with severe anemia is twice that of mothers without severe anemia due to severe hemorrhage at delivery or postpartum or complications due to anemia, such as heart failure. In terms of fetal outcomes, anemia increases the occurrence of perinatal morbidities, such as prematurity due to spontaneous preterm birth and low birth weight [9].

This study can be a good basis for further studies in a specific area depending on its findings or the association between variables. Therefore, this study will intend to determine the prevalence of anemia and associated factors among pregnant women attending Maternity and Childhood Al-Sabeen Hospital, Sana'a City, Yemen, to help reduce this problem by providing information and data to authorities and decision-makers to create and implement health education and health promotion programs.

2. MATERIALS AND METHODS

This cross-sectional study investigated the prevalence and risk factors of anemia among 376 pregnant women aged 18–38 years (because less than 18 years are still growing, meaning their basic nutritional needs overlap significantly with the demands of pregnancy. This may skew or distort the risk factors for anemia in the study compared to full-term adults.) attending antenatal care services (ANC) at Maternity and Childhood Al-Sabeen Hospital in Sana'a, Yemen, between October 2024 and August 2025. Data on socio-demographic, clinical, and dietary variables were collected via structured Arabic interviews.

Study Design: A hospital-based cross-sectional study.

Study Setting: Maternity and Childhood Al-Sabeen Hospital, Sana'a City, Yemen.

Study Period: October 7, 2024, to August 30, 2025.

Study Population: Pregnant women attending Antenatal Care (ANC) services at the study site.

Inclusion Criteria: Pregnant women aged 18 years or older attending ANC during the study period.

Exclusion Criteria: Women with chronic illnesses causing anemia (e.g., sickle cell disease, thalassemia, chronic kidney disease), infectious diseases (HIV/AIDS or malaria), or unable to provide informed consent.

Sample Size: A minimum of 379 pregnant women, calculated using Open Epi version 3 based on an expected 44.2% anemia prevalence, 80% power, and 95% confidence interval.

Data Collection & Measurement Tools (Questionnaire): A structured, face-to-face interview in Arabic (translated from English), designed based on previous literature [5, 6].

Components: Part I (Socio-demographic), Part II (Clinical & Obstetric), Part III (Dietary habits).

Haematology assessment: A 3 mL whole venous blood sample was collected from each patient under sterile conditions. Hemoglobin levels were then measured to determine anemia status, as previously described [10–12], by measuring hemoglobin concentration and performing a complete blood count. This was done using an automated complete blood count (CBC) system employing flow cytometry (for cell counting and sizing) and spectrophotometry (for hemoglobin measurement) with an Advia 2120i hematology analyzer (Siemens,

Germany) at the National Public Health Laboratory in Sana'a, Yemen.

Ethical considerations

Before providing their written approval, all pregnant women who were participate in this study were receive a consent form and details regarding the aims and procedures of the study. The Faculty of Medicine and Health Science's committee on postgraduate studies and scientific research was approved the study.

Statistical analysis

Data were entered into Statistical Package for Social Sciences software version 25.0 (SPSS Inc., Chicago, USA). Descriptive statistics: The study population's characteristics were summarized, using means with SDs for the continuous variables and frequency and percentages for the categorical variables. A binary and multivariable logistic regression test were used to estimate odds ratio (OR) and (AOR) and to determine the associations between independents and dependents variables with 95% confidence interval (CIs), two-sided test was level of significant at $\alpha < 0.05$ was used.

3. RESULTS

This part presents the results of the current study from the data collected of the study sample. It presents the prevalence of anemia, social-demographic features, and related factors of the study sample. It describes the characteristics of 376 pregnant women, who were recruited from – Al-Sbeen Maternal and Child care in Sana'a City - The response rate by the participants in the study was 100%.

As shown in Figure 2, the overall prevalence of anemia in this population was 27.9% (105) cases. The burden is mostly attributed to less severe cases. Specifically, 16.0% of cases (60 cases) were classified as mild, and 11.7% (44 cases) as moderate, while severe anemia was very rare, with only one case (0.3%) recorded.

Table 1 summarizes the clinical and obstetric history of 376 pregnant women. A significant majority were multiparous (64.1%), whereas nulliparous women comprised only 3 cases (0.8%). Additionally, 70 women (18.6%) reported a history of abortion. Pregnancy spacing presents a potential health concern, as 282 participants (75%) had an interpregnancy interval of two years or less (mean of 1.82 years). Most participants (189 cases, 50.3%) were in their third trimester. Despite 46 cases (12.2%) reporting bleeding complications, the cohort generally exhibits a favorable health status, as 345 women (91.8%) reported no other health problems, pointing to a potential for positive pregnancy outcomes.

Table 2 illustrates the dietary habits of 376 pregnant women at Al-Sabeen Maternity and Children's Hospital in Sana'a, Yemen, during 2025. The data reveals an iron supplement use rate of 67.6%, compared to a non-adherence or non-use rate of 32.4%, along with specific consumption patterns for micronutrients and macronutrients. Regarding supplements and their intake, 254 participants (67.6%) reported using iron supplements, while 122 participants (32.4%) reported not using them. As for vegetable consumption, 116 participants (30.9%) reported daily consumption, 128 participants (34.0%) reported weekly consumption, and 6 participants (1.6%) did not consume vegetables at all. Regarding fruit consumption, 31 participants (8.2%) reported daily consumption, while 171 participants (45.5%) reported weekly consumption. Regarding protein and beverage habits, daily meat consumption was limited to 24 participants (6.4%), while 46 participants (12.2%) reported avoiding it completely. As for post-meal beverages, tea or coffee consumption was common among 256 participants (68.1%). Table 3 presents the laboratory parameters for 376 pregnant women. The mean white blood cell count was $8.25 \times 10^9/L$, indicating a healthy immune response. The mean red blood cell count was $4.44 \times 10^{12}/L$, with a hemoglobin level of 12.2 g/dL, both within the normal range, although monitoring for anemia is recommended. The packed cell volume was 35.85%, reflecting adequate hydration. Key parameters, such as mean corpuscular volume and mean corpuscular hemoglobin, indicate normal red blood cell characteristics. The platelet count was $254 \times 10^9/L$, which is also within the normal range. Notably, the neutrophil count was 65.1%, within the normal range for pregnant women, while the lymphocyte level of 25.8% reflects healthy immune function. Overall, the laboratory parameters indicate good health in the women, although some parameters should be monitored.

In Table 4, regarding maternal age, young adults (18–24 years) showed an increased risk of anemia compared to the control group (25–31 years; odds ratio = 1.96, $p = 0.017$), while the 32–38-year age group showed a marginally positive trend (odds ratio = 1.76, $p = 0.055$). In terms of socioeconomic indicators, monthly household income showed a protective inverse association, with earnings between 71,000 and 90,000 Yemeni rials (odds ratio = 0.36, $p = 0.018$) and those exceeding 90,000 (odds ratio = 0.51, $p = 0.035$) significantly reducing the likelihood of anemia. Regarding null associations, geographic residence, occupational status, and type of housing showed no statistically significant associations with anemia status in this cohort of 376 individuals. Regarding family dynamics, a marginal correlation was observed with an increased risk among women residing in large families with more than eight members (odds ratio = 1.68, probability value = 0.054), although it did not reach the level of traditional significance.

Table 5 does not show strong associations between clinical



cal history and anemia in pregnant women. Most values lack statistical rigor. Regarding nullity, the odds ratio was higher (3.3), but with low rigor. Regarding birth history, women who had given birth for the first time (0.556) and those who had given birth multiple times (0.590) showed lower odds, but these were not statistically significant. Regarding a history of miscarriage, the odds ratio was 1.57, but it was not strong ($p = 0.109$). Regarding birth spacing and gestational intervals, there was no clear association or change between gestational intervals. Regarding bleeding and health, bleeding showed an odds ratio of 1.61 ($p = 0.148$) and health problems 1.06 ($p = 0.886$), both of which were not statistically significant (Table 5).

Table 6 shows that daily and monthly meat consumption significantly reduces the risk of anemia in pregnant women, while fruits, vegetables, iron supplements, and tea or coffee after meals show no significant effects. Regarding meat and supplements, a significant reduction in the risk of anemia was observed with daily meat consumption (odds ratio 0.13, $p = 0.010$) due to its high iron content. With monthly meat consumption, a moderate reduction in risk was observed (odds ratio 0.39, $p = 0.018$). A semi-significant protective effect was observed with folic acid intake (odds ratio 0.56, $p = 0.053$). No statistically significant association was observed with iron supplements (odds ratio 0.89, $p = 0.636$). Fruits and vegetables also had no significant effect on anemia. Finally, no significant effect of tea and coffee after meals was observed (odds ratio 0.81, $p = 0.39$) (Table 6).

A negative association between white blood cell (WBC) count and hemoglobin levels (coefficient of -0.070, $p=0.002$) suggests that increased WBC counts, often linked to infection or inflammation, can lower hemoglobin production. Conversely, red blood cell (RBC) count is positively associated with hemoglobin (coefficient of 1.352, $p=0.000$), affirming RBCs' role in oxygen transport. Packed cell volume (PCV) also shows a strong positive relationship with hemoglobin (coefficient of 0.323, $p=0.000$). Mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) have positive coefficients (0.106 and 0.253, respectively, both $p=0.000$), indicating their importance in assessing anemia. Mean corpuscular hemoglobin concentration (MCHC) is similarly significant (coefficient of 0.635, $p=0.000$). In contrast, a negative coefficient for red cell distribution width (RDW-CV) (-0.064, $p=0.000$) signifies that variations in red blood cell size may indicate nutritional deficiencies or inflammatory issues. Among leukocytes, neutrophils negatively impact hemoglobin status, while lymphocytes positively influence it. Eosinophils show significance but need further research, whereas monocytes and basophils lack significant correlation (Table 7).

Multivariable logistic regression analysis of factors associated with severity of anemia

Based on multivariate logistic regression analysis, several factors were significantly associated with anemia in pregnant women. Maternal age shows that women aged 18–24 years have 1.91 times higher odds of anemia than those aged 25–31 years. Socioeconomic status was reflected in income, with women earning 71, 000–90, 000 Yemeni Rials having 67% lower odds of anemia. A larger family size (more than eight persons) was linked to 2.79 times higher odds of anemia, while grand multiparous women had 2.97 times higher odds. Short interpregnancy intervals (2 years) increased the odds by 2.21 times. Notably, infrequent meat consumption correlated strongly with anemia, with the odds increasing from 8.11 times for once a week to 11.85 times for never consuming meat (Table 8).

4. DISCUSSION

The study identified a 27.9% anemia prevalence among pregnant women at Maternity and Childhood Al-Sabeen Hospital in Sana'a, which is lower than the 26.8% reported by Al-Agmer et al [13]. and significantly less than the WHO's 2019 estimate of 57.5% [12]. Local studies have reported rates between 25% and 44.2%. Regionally, this prevalence aligns with findings from Saudi Arabia (34.1%) and Ethiopia (24–29%), but is lower than rates in Sudan (42.3%), Somalia (44.5%), and Pakistan (40%) [14–19]. Factors influencing these variations include dietary habits, socioeconomic conditions, healthcare access, and research methodologies (**research methodologies strongly bias the documented variations of Hepatitis B Virus (HBV)** by altering how viral genotypes, sub-genotypes, and mutations are captured, sequenced, and interpreted). An analysis from 2000 to 2019 highlights a decline in average anemia rates among pregnant women, while low-income countries report higher burdens, with Yemen's 27.9% rate representing a significant public health challenge consistent with similarly affected nations in the region [20, 21].

Transitioning from prevalence to causative factors, key risks for anemia in pregnant women are highlighted in the Eastern Mediterranean, particularly in Yemen. Studies indicate that low socioeconomic status and family income significantly contribute to this issue, linking economic hardship to poor nutrition and limited healthcare access. Additionally, reproductive health patterns, such as short intervals between pregnancies, are associated with a heightened risk of anemia, a trend observed in both Yemen and Bahrain [5,6]. Research in Sana'a indicates that nutritional factors and existing health issues significantly contribute to anemia. Key findings reveal that never consuming liver and lacking iron and folic acid supplementation are notable risk factors. Anemia is identified as a multifactorial condition, with iron deficiency as

a primary cause, but also highlights inadequate dietary intake, poor iron absorption, and comorbidities as prevalent themes in regional studies [5, 6, 21].

Regarding the severity of anemia, the present study demonstrated that mild anemia (16.0%) and moderate anemia (11.7%) constituted the majority of cases, while severe anemia was rare (0.3%). This pattern is consistent with several studies conducted in low- and middle-income countries, which reported that mild and moderate anemia predominate during pregnancy [16, 22]. Similarly, studies from Ethiopia and India reported severe anemia rates of less than 1%, emphasizing that although anemia is common, life-threatening forms are relatively uncommon among antenatal clinic attendees [23]. The low proportion of severe anemia in the current study may reflect early detection through routine antenatal screening and timely iron supplementation.

The multivariable logistic regression analysis revealed that maternal age (18–24 years) was independently associated with anemia. Younger pregnant women were nearly twice as likely to be anemic compared to women aged 25–31 years. This finding aligns with previous studies conducted in Yemen and Ethiopia, which reported higher anemia prevalence among younger women due to increased nutritional demands, limited dietary diversity, and early marriage [6, 16]. In contrast, maternal residence and occupation were not significantly associated with anemia in the present study. This finding is consistent with studies conducted in urban hospital settings, where access to antenatal services tends to reduce rural–urban disparities [24]. However, it contrasts with studies from rural Ethiopia and Sudan, where occupation and rural residence was a significant predictor of anemia [14, 16, 25].

Monthly family income emerged as a significant protective factor. Women with higher income levels (71,000–90,000 YR) had significantly lower odds of anemia. This finding corroborates evidence from previous studies indicating that improved socioeconomic status enhances dietary quality and healthcare utilization, thereby reducing anemia risk [26]. Furthermore, large family size (>8 members) was independently associated with increased anemia risk. This association is consistent with findings from Yemen and other low-income settings, where larger families often experience food insecurity and resource dilution, negatively impacting maternal nutrition [5, 25, 27].

Regarding obstetric characteristics, grand multiparity was significantly associated with a higher risk of anemia. Specifically, women with multiple previous pregnancies experienced approximately three-fold higher odds of developing the condition. These findings are consistent with previous studies conducted in Yemen, Sudan, and India, which attributed this association to cumulative iron depletion from repeated pregnancies and inadequate replenishment of iron stores [22, 28]. Additionally, a short

interpregnancy interval (≤ 2 years) was significantly associated with anemia. This finding aligns with WHO recommendations emphasizing adequate birth spacing for maternal nutritional recovery [26]. Similar associations between short birth intervals and maternal anemia have been reported in studies from Ethiopia, Pakistan, and Tanzania [16, 29, 30].

Conversely, factors such as history of abortion, gestational age, antepartum hemorrhage, and co-existing health conditions showed no significant relationship with anemia in this study. While in agreement with some literature, these results contradict studies finding higher third-trimester prevalence due to hemodilution [31]. This discrepancy suggests that, in this study, rigorous antenatal care and, likely, universal supplementation mitigated the impact of these risk factors." Dietary factors played a crucial role in anemia status. Notably, daily meat consumption was strongly protective against anemia, while even monthly meat consumption significantly reduced anemia risk. This finding is biologically plausible, as meat is a rich source of heme iron, which has higher bioavailability compared to plant-based iron [32]. Similar protective effects of meat consumption have been reported in previous studies [29, 33]. In contrast, vegetable and fruit consumption did not show significant associations with anemia in the present study. This may be attributed to the low iron bioavailability from plant sources and possible concurrent intake of iron absorption inhibitors.

Iron supplementation was not significantly associated with anemia, which contrasts with several studies reporting its protective effect [22, 26]. This discrepancy may reflect poor adherence, late initiation, or inadequate dosing of supplements. Meanwhile, folic acid supplementation approached statistical significance, suggesting a potential protective role that warrants further investigation.

The analysis of laboratory variables revealed strong associations between hemoglobin levels and erythrocyte indices (RBCs, PCV, MCV, MCH, and MCHC), which is consistent with established hematological principles [34]. The negative association between RDW and hemoglobin suggests anisocytosis related to iron deficiency or mixed anemia, as reported in previous study [35]. Moreover, elevated WBC and neutrophil counts were negatively associated with hemoglobin levels, possibly reflecting inflammatory or infectious processes that impair erythropoiesis. Similar findings have been reported in studies linking inflammation-induced anemia with elevated leukocyte counts [27, 35].

5. LIMITATION OF THE STUDY

The study's limitations include its cross-sectional design, which establishes association rather than causality, and the use of hospital-based, self-reported data that may not represent the general population due to potential



recall bias [1, 2, 5]. Additionally, the research did not account for all biological factors like parasitic infections and is limited in generalizability to rural areas.

6. CONCLUSION

Overall, this study highlights that anemia among pregnant women in Sana'a City—specifically at the Al-Sabeen Maternity and Child Hospital—remains a significant yet preventable public health concern affecting over 25% of the population. Predominant risk factors include young maternal age, low income, large family size, grand multiparity, short birth intervals, and inadequate meat consumption. Although most diagnosed cases are mild to moderate, the condition still poses serious risks to maternal and fetal well-being. Ultimately, these findings underscore the multifactorial nature of gestational anemia, where socioeconomic conditions, obstetric history, and hematological profiles intersect, with dietary practices—particularly iron-rich meat intake—playing a critical role.

7. RECOMMENDATION

For further research, longitudinal studies should be conducted to identify causal relationships, verify micronutrient deficiencies using biomarkers, and explore dietary factors affecting iron absorption in different regions of Yemen.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY

The empirical data used to support the study's results can be obtained upon request from the corresponding author.

AUTHOR'S CONTRIBUTIONS

Amel Saleh Ahmed Nagi Al-Adeel, Master's student: writing the original draft, methodology, investigation. Prof. Mohammed Abdulkader Al-Nuzaili: design and super-

vision of clinical work. Prof. Hassan Abdulwahab Al-Shamahy and Ammar Al-Dhahari : Formal analysis, data processing, and review of the final draft of the thesis and article.

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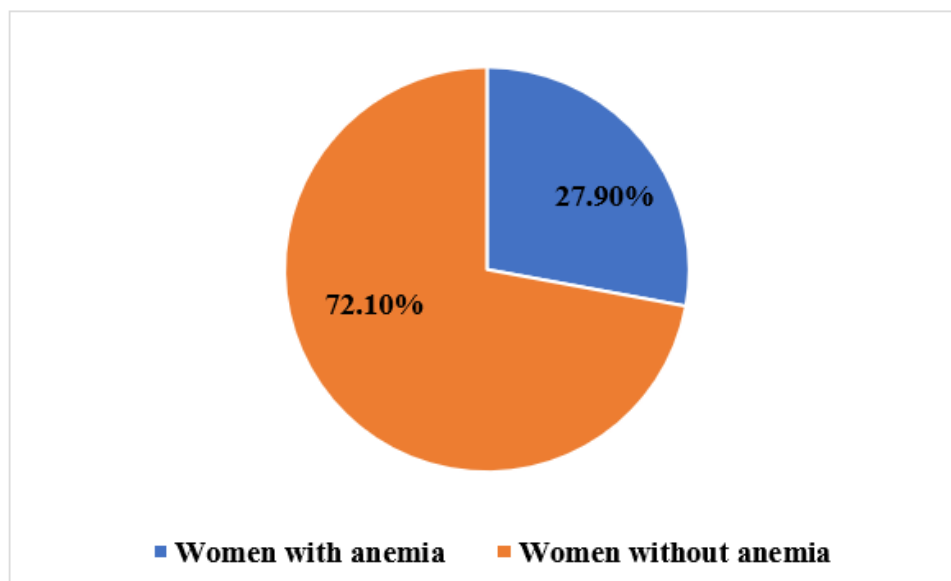


Figure 1. Prevalence of anemia among pregnant attending Maternity and Childhood Al-Sabeen Hospital, Sana'a City, Yemen, 2025 (n = 376)

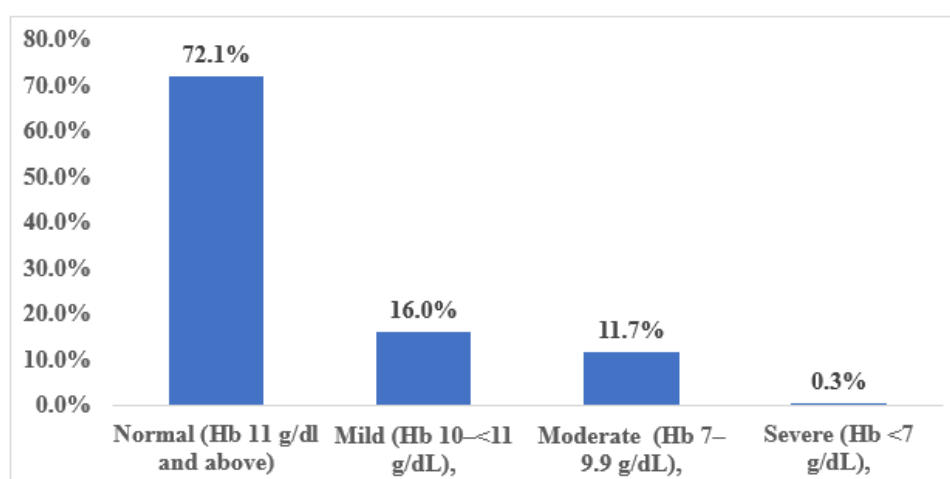


Figure 2. Prevalence of anemia among pregnant attending Maternity and Childhood Al-Sabeen Hospital by category, Sana'a City, Yemen, 2025 (n = 376))

Table 1. Clinical and Obstetric history variables of the pregnant women participated in the study (N = 376)

Variable	Category	Frequency (F)	Percent (%)
History of Pregnancy	Nullipara	3	0.8
	Primipara	76	20.2
	Multipara	241	64.1
	Grand multipara	56	14.9
History of abortion	Yes	70	18.6
	No	306	81.4
Spacing between last and current pregnancy	≤ 2	282	75.0
	> 2	94	25.0
Mean ± SD	1.82±1.68 years		
Current trimester	First	39	10.4
	Second	148	39.4
	Third	189	50.3
Bleeding on current pregnancy	Yes	46	12.2
	No	330	87.8
Health problem during current pregnancy	Yes	31	8.2
	No	345	91.8

Table 2. Dietary habits variables of the pregnant women participated in the study (N = 376)

Variable	Category	Frequency (F)	Percent (%)
Iron supplementation	Yes	254	67.6
	No	122	32.4
Habit of vegetable use	Daily	116	30.9
	Once a week	128	34.0
	Twice a week	89	23.7
	Once month	37	9.8
	Never	6	1.6
Habit of fruit use	Daily	31	8.2
	Once a week	171	45.5
	Twice a week	88	23.4
	Once month	80	21.3
	Never	6	1.6
Habit of meat use	Daily	24	6.4
	Once a week	151	40.2
	Twice a week	67	17.8
	Once month	88	23.4
	Never	46	12.2
Consumption of tea and coffee immediately after meal	Yes	256	68.1
	No	120	31.9

**Table 3.** Laboratory variables of the pregnant women participated in the study

Items	Median	Interquartile range (IQR)
WBCs	8.25	6.22–10.63
RBCs	4.44	4.09–4.78
HGB	12.2	10.83–13.18
PCV	35.85	32.60–38.90
MCV	82.05	77.40–86.05
MCH	27.7	25.60–29.50
MCHC	33.7	32.90–34.58
RDW_CV	13.9	12.80–14.88
PLT	254	206–303.0
Neutrophil	65.1	56.30–73.95
Lymphocyte	25.8	18.23–32.80
Monocyte	6.7	5.50–8.10
Eosinophil	1.3	0.50–2.50
Basophil	0.3	0.20–0.50

WBCs: White blood cells; RBCs: Red blood cells; HGB: Hemoglobin; PCV: Packed cell volume (or hematocrit); MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; RDW-CV: Red cell distribution width-coefficient of variation; PLT: Platelets.

Table 4. Association between various demographic and socioeconomic factors and anemic status of the pregnant women participated in the study ($N = 376$)

Variables/Factors	Anemic Status (N = 376)		^a COR	^b 95% C.I.	*P value
	Women without anemia (n = 271) n (%)	Women with anemia (n = 105) n (%)			
Maternal age (years)					
18–24	65 (65.0)	35 (35.0)	1.96	1.13–3.40	0.017
25–31	131 (78.4)	36 (21.6)	1.00		
32–38	60 (67.4)	29 (32.6)	1.76	0.99–3.13	0.055
> 38	15 (75.0)	5 (25.0)	1.21	0.41–3.56	0.725
Residence					
Urban	212 (71.4)	85 (28.6)	0.85	0.48–1.49	0.561
Rural	59 (74.7)	20 (25.3)	1.00		
Occupation					
Housewife	219 (73.0)	81 (27.0)	0.70	0.30–1.63	0.407
Public employment	17 (58.6)	12 (41.4)	1.33	0.46–3.99	0.607
Private employment	18 (85.7)	3 (14.3)	0.31	0.07–1.36	0.122
Self-employment	17 (65.4)	9 (34.6)	1.00		
Monthly income (YR)					
< 50000 YR	97 (71.9)	38 (28.1)	0.65	0.37–1.14	0.132
50000–70000 YR	58 (62.4)	35 (37.6)	1.00		
71000–90000 YR	41 (82.0)	9 (18.0)	0.36	0.16–0.84	0.018
> 90000 YR	75 (76.5)	23 (23.5)	0.51	0.27–0.95	0.035
Family size					
≤ 4 persons	52 (73.2)	19 (26.8)	1.10	0.60–2.02	0.768
5–8 persons	162 (75.0)	54 (25.0)	1.00		
> 8 persons	57 (64.0)	32 (36.0)	1.68	0.99–2.87	0.054
Type of house					
Own	140 (73.7)	50 (26.3)	1.18	0.75–1.85	0.482
Rent	131 (70.4)	55 (29.6)	1.00		

^aCOR: crude odds ratio; ^b95% C.I.: confidence interval; ^{*} $P < 0.05$ statistically significant.

Table 5. Association between clinical and obstetric history factors and anemic status of the pregnant women participated in the study (N = 376)

Variables/Factors	Anemic Status (N=376)		^a COR	^b 95% C.I.	*P value
	Women without anemia (n=271) n (%)	Women with anemia (n=105) n (%)			
History of Pregnancy					
Nullipara	1 (33.3)	2 (66.7)	3.333	0.29–39.04	0.338
Primipara	57 (75.0)	19 (25.0)	0.556	0.26–1.18	0.124
Multipara	178 (73.9)	63 (26.1)	0.590	0.32–1.09	0.091
Grand multipara	35 (62.5)	21 (37.5)	1.00		
History of abortion					
Yes	45 (64.3)	25 (35.7)	1.57	0.90–2.72	0.109
No	226 (73.9)	80 (26.1)	1.00		
Spacing between last and current pregnancy					
0	55 (75.3)	18 (24.7)	0.68	0.37–1.24	0.21
1–2 yrs	141 (67.5)	68 (32.5)	1.00		
3–4 yrs	58 (78.4)	16 (21.6)	0.572	0.31–1.07	0.080
> 5 yr	17 (85.0)	3 (15.0)	0.366	0.10–1.29	0.118
Current trimester					
First	28 (71.8)	11 (28.2)	0.887	0.41–1.90	0.759
Second	112 (75.7)	36 (24.3)	0.726	0.45–1.18	0.197
Third	131 (69.3)	58 (30.7)	1.00		
Bleeding on current pregnancy					
Yes	29 (63.0)	17 (37.0)	1.61	0.85–3.08	0.148
No	242 (73.3)	88 (26.7)	1.00		
Health problem during current pregnancy					
Yes	22 (71.0)	9 (29.0)	1.06	0.47–2.39	0.886
No	249 (72.2)	96 (27.8)	1.00		

^aCOR: crude odds ratio; ^b95% C.I.: confidence interval; * $P < 0.05$ statistically significant.

**Table 6.** Association between dietary habits factors and anemic status of the pregnant women participated in the study (N = 376)

Variables/Factors	Anemic Status (N=376)		^a COR	^b 95% C.I.	*P value
	Women without anemia (n=271) n (%)	Women with anemia (n=105) n (%)			
Folic acid supplementation					
Yes	236 (74.0)	83 (26.0)	0.56	0.31–1.01	0.053
No	35 (61.1)	22 (38.6)	1.00		
Iron supplementation					
Yes	185 (72.8)	69 (27.2)	0.89	0.55–1.44	0.636
No	86 (70.5)	36 (29.5)	1.00		
Habit of vegetable use					
Daily	84 (72.4)	32 (27.6)	1.90	0.21–16.94	0.563
Once a week	93 (72.7)	35 (27.3)	1.88	0.21–16.68	0.570
Twice a week	64 (71.9)	25 (28.1)	1.95	0.21–17.56	0.550
Once month	25 (67.6)	12 (32.4)	2.40	0.25–22.89	0.447
Never	5 (83.3)	1 (16.7)	1.00		
Habit of fruit use					
Daily	27 (38.7)	4 (12.9)	0.74	0.07–8.09	0.806
Once a week	121 (70.8)	50 (29.2)	2.07	0.24–18.14	0.513
Twice a week	64 (72.7)	24 (27.3)	1.87	0.21–16.88	0.575
Once month	54 (67.5)	26 (32.5)	2.41	0.27–21.67	0.433
Never	5 (83.3)	1 (16.7)	1.00		
Habit of meat use					
Daily	22 (91.7)	2 (8.3)	0.13	0.03–0.62	0.010
Once a week	107 (70.9)	44 (29.1)	0.58	0.30–1.16	0.124
Twice a week	46 (68.7)	21 (31.3)	0.65	0.30–1.42	0.278
Once month	69 (78.4)	19 (21.8)	0.39	0.18–0.85	0.018
Never	27 (58.7)	19 (41.3)	1.00		
Consumption of tea and coffee immediately after meal					
Yes	188 (73.4)	68 (26.6)	0.81	0.50–1.31	0.39
No	83 (69.2)	37 (30.8)	1.00		

^aCOR: crude odds ratio; ^b95% C.I.: confidence interval; * P<0.05 statistically significant.**Table 7.** Association between Hemoglobin status and Laboratory results among pregnant women participated in the study (N = 376)

Variables/Factors	Coefficients B	Std. Error	t	^b Sig.	95.0% Confidence Interval for B	
					Lower Bound	Upper Bound
WBCs	-0.070	0.023	-3.055	0.002	-0.115	-0.025
RBCs	1.352	0.120	11.310	0.000	1.117	1.588
PCV	0.323	0.007	45.128	0.000	0.309	0.337
MCV	0.106	0.010	10.298	0.000	0.086	0.126
MCH	0.253	0.023	11.203	0.000	0.209	0.298
MCHC	0.635	0.055	11.597	0.000	0.528	0.743
RDW CV	-0.064	0.015	-4.386	0.000	-0.093	-0.035
PLT	0.002	0.001	1.906	0.057	-0.000	0.004
Neutrophil	-0.035	0.006	-5.742	0.000	-0.047	-0.023
Lymphocyte	0.041	0.007	5.929	0.000	0.028	0.055
Monocyte	0.040	0.036	1.125	0.261	-0.030	0.110
Eosinophil	0.132	0.045	2.927	0.004	0.043	0.220
Basophil	0.029	0.334	0.085	0.932	-0.628	0.685

D Dependent Variable: HB category; B-Unstandardized Coefficients; CI-Confidence Interval for B; ^bSig.: p-value < 0.05 as statistically significant.

Table 8. Multivariable logistic regression analysis of factors associated with anemia among pregnant women participated in the study (N = 376)

Variables/Factors	^a B	^b AOR	^c 95% C.I.		*P-value
			Lower	Upper	
Maternal age (years)					
18–24	0.646	1.91	1.01	3.59	0.045
25–31		Ref.			
32–38	0.558	1.75	0.92	3.33	0.089
> 38	0.191	1.21	0.37	3.96	0.753
Monthly income (YR)					
< 50000 YR	-0.185	0.83	0.49	1.42	0.499
50000–70000 YR		Ref.			
71000–90000 YR	-1.109	0.33	0.11	0.98	0.047
> 90000 YR	-0.412	0.66	0.19	2.32	0.519
Family size					
≤ 4 persons	0.440	1.55	0.90	2.68	0.113
5–8 persons		Ref.			
> 8 persons	1.026	2.79	1.11	6.99	0.028
History of Pregnancy					
Nullipara	1.277	3.58	0.20	63.07	0.383
Primipara		Ref.			
Multipara	0.306	1.36	0.69	2.67	0.375
Grand multipara	1.089	2.97	1.21	7.32	0.018
Spacing between last and current pregnancy					
≤ 2	0.793	2.21	1.13	4.32	0.021
> 2		Ref.			
Habit of meat use					
Daily		Ref.			
Once a week	2.092	8.11	1.63	40.21	0.010
Twice a week	2.221	9.22	1.75	48.66	0.009
Once month	1.597	4.94	0.95	25.68	0.058
Never	2.473	11.85	2.20	63.92	0.004

^aB: Coefficient; ^bAOR: Adjusted odds ratio; ^c95% C.I.: Confidence interval; *P-value < 0.05 statistically significant; Ref.: Reference group.