Prevalence and risk factors among anemia during pregnancy: A cross-sectional study at the Authority of Al-Thawrah General Hospital, Hodeidah, Yemen

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Abstract
Background: The prevalence of anemia in pregnancy, which ranges from 41.8% globally to up to 54% in the Middle East, is a severe global health issue. **Aim of this study:** This study aims to identify associations between anemia in expectant mothers and risk variables in Hodeidah, Yemen. **Subjects and Methods: Research Design:** We adopted a cross-sectional research design to conduct this study. **Setting:** The study was conducted at the Authority of Al-Thawrah General Hospital in Hodeidah, Yemen. **Subjects:** A convenience sample of 350 expectant mothers. **Tools of data collection:** A standardized questionnaire, laboratory tests and medical records were used to collect the data from studied cases. **Results:** The frequency of anemia was 76.86%, which is higher than previous regional studies and comparable to African studies. The majority of patients (55.76% to 41.64%) had mild to moderate anemia. Combined hormonal contraceptives (CHCs) were a protective factor against anemia (OR 0.36, p=0.006). **Conclusion:** The study highlights the significant anemia frequency and severity among expecting mothers in Hodeidah, Yemen. **Recommendations:** This study recommended that, to improve prenatal care and early anemia detection, macro and micro-interventions are required. Additional research into associated risk factors might direct focused mitigation efforts for this population.
Keywords: Anemia, Hodeidah, Pregnant women, Prevalence, Risk factors, Yemen.

Introduction:
Anemia is a worldwide public health issue that has a significant impact on social and economic development as well as human health in both developed and developing nations. Although it can occur at any stage of life, pregnant women and newborn are more likely to experience it **(Berhe et al., 2019).** More recent researches found, 52% of pregnant women globally suffer from anemia. Most of these ladies were residents of poor nations **(Young et al., 2019).** The WHO reports that between 1995 and 2011, the prevalence of anemia among pregnant women aged 15 to 49 years decreased by 12%, from 43% to 38% **(World Health Organization, 2014).**

According to **Lin et al. (2018),** anemia in pregnancy is characterized by a drop in the concentration of circulating red blood cells or hemoglobin (Hemoglobin levels below 11 g/dl) and a correspondingly compromised ability to transport oxygen. There are several contributing factors to anemia. Iron deficiency is the cause of at least half of the anemia in pregnant cases that occur worldwide. Chronic inflammation, parasite infections, genetic illnesses, and nutritional deficits of folate, vitamin B12, and vitamin A are further contributing factors **(Al-Aini et al., 2020).**

Pregnancy-related anemia is significantly influenced by cultural differences in lifestyle, health-seeking practices, and financial circumstances. Pregnancy-related anemia has been linked to negative outcomes that may impact not only the expectant mother but also the newborn and baby **(Adam et al., 2018).** Numerous negative effects for both mother and child are linked to anemia during pregnancy, such as a higher risk of bleeding, sepsis, maternal and perinatal deaths, low birth weight, and diminished job capacity.

Anaemia accounts for 40% of all perinatal fatalities. Maternal hemoglobin levels below 8.0 g/d1 typically result in a 2–3 times increase in the perinatal mortality rate, while levels below 5.0 g/dl typically result in an 8-10 fold increase **(Beckert et al., 2019).**

The management of anemia in a pregnant woman depends on the duration of pregnancy, severity of the anemia and complications. According to the WHO, treating anemia with a combination of iron and vitamin A may be more effective, Yemen face.

Significance of the study:

In Yemen, anemia is one of the serious health problems among pregnant women. The World Bank estimated the prevalence of anemia in Yemen to be 36% among pregnant women **(The World Bank, 2015).** The health of women and children was severely affected by the war and the siege in Yemen. Evidence suggested that women's and children's health impacts of conflict were ignored. Yemen's westernmost coastal governorate is called Hodeidah. It is one of the governorates in Yemen with the biggest population, with around 3 million inhabitants, the majority of whom are engaged in subsistence farming and fishing. It has the lowest human development indexes and the greatest rates of poverty. It contains 26 districts and is one of the governorates with the highest malnutrition rates. It is consisting of a significant part of high complicated maternal mortality ratio. The scope of this study is to explore prevalence and determinants of anemia in pregnant women at The Authority of AL-Thawrah General hospital.

Aims of the study:

This study aimed to find out the prevalence of anemia and associated factors among pregnant women attending antenatal clinics at The Authority of AL-Thawrah General hospital, Hodeidah, Yemen.

particularly in the second trimester of pregnancy. Iron fortification and supplementation, dietary changes, health and nutritional education, parasite infection prevention, and sanitation enhancement are among the interventions used to manage anemia during pregnancy **(Acheampong et al., 2018).** This study was conducted to identify the risk factors for anemia among pregnant women because it is one of the major health issues that pregnant women in

Research Questions:

1. What is the prevalence of anemia among pregnant women attending antenatal clinics in The Authority of AL-Thawrah General hospital, Hodeidah, Yemen?
2. What are the associated risk factors for the occurrence of anemia among pregnant women attending antenatal clinics in The Authority of AL-Thawrah General hospital, Hodeidah, Yemen?

Subjects and methods:

Research design:

A cross-sectional research design was adopted to carry out this study.

Study setting:

The study was conducted at the Authority of Al-Thawrah General Hospital in Hodeidah, Yemen. This hospital serves as a major healthcare facility in the region, providing maternity and prenatal care to many pregnant women from different socioeconomic backgrounds**.**

Study subjects:

A convenience sample of 350 pregnant women attending the hospital for routine antenatal care during the study period, ensuring ease of access and a practical approach to recruitment. The sample size was determined based on the expected prevalence of anemia in pregnancy in the region, with a confidence level of 95% and a margin of error of 5%. Assuming an estimated anemia prevalence of 40%, the required sample size can be calculated using standard sample size formulas. A sample

size was collected during the period from November 2023 to March 2024.

Inclusion criteria:

- Pregnant women attending antenatal clinics at the hospital.
- Women who are in their second or third trimester (gestational age > 12 weeks).
- Women who consent to participate in the study.

Exclusion criteria:

- Women with pre-existing conditions like hemoglobinopathies (e.g., sickle cell anemia, thalassemia) that could confound the anemia diagnosis.

Tools of data collection:

Data was collected using the following tools:

Tool (I): Structured questionnaire: A pre-designed questionnaire gathered socio-demographic information (age, residency, occupation, socioeconomic status, education level), obstetric history (parity, gestational age, previous mode of delivery), dietary habits, and known risk factors for anemia.

Tool (II): Laboratory tests: Blood samples were collected from participants to measure hemoglobin levels and diagnose anemia. According to the classification of World Health Organization (WHO), pregnant women with hemoglobin levels less than 11.0 g/dl in the first and third trimesters and less than 10.5 g/dl in the second trimester are considered anemic **(WHO, 1998).**

Tool (III): Medical records: Relevant clinical data from the hospital's medical records was reviewed to obtain information on previous obstetric history, complications, and comorbidities.

Content validity and reliability:

The questionnaire was translated into Arabic; and then content and face validity were established by a panel of five experts at the Medicine and health science Faculty, Hodiedah University. Experts were requested to express their opinions and comments on the tool and provide any suggestions for any additions or omissions of items. According to their opinions, all recommended modifications were performed by the researchers. Reliability was measured by using the Cronbach's Alpha Coefficient factor test to determine the internal consistency of each scale and all were satisfactory for the Servant leadership instrument (0.986), and self-efficacy Cranach's Alpha was (0.959).

Pilot study:

A pilot study was carried out on 10 % of study subjects (35 pregnant woman) to test applicability, feasibility, practicability of the tools. In addition, to estimate the time required for filling in the questionnaire sheets. The pilot study was conducted one week before collection of data and pregnant woman were selected randomly and they were excluded from the main study sample.

Filed work:

The fieldwork was involve recruiting participants from the antenatal clinic at Al-Thawrah General Hospital. After obtaining informed consent, the researchers were fill out the structured questionnaire from the pregnant woman who gave her verbal informed consent to participate. then Blood samples was be taken by trained healthcare professionals for laboratory analysis. Data collection was be carried out over a period of 5 months to ensure a representative sample.

Administration and ethical consideration:

Official permissions were obtained from the dean of the medicine and health science Faculty Hodeidah University, and approval to conduct the study was obtained from the director of Althawra hospital after explaining the nature of the study. The study was approved by ethics committee in the faculty with an ethical code 302/2023 date: 13/ 10/2023. As well, of the verbal explanation of the nature and aim of the study had been explained to participants included in the study sample. Likewise, an individual oral consent was received from each participant in the study after explaining the purpose of the study.

Confidentiality: participants' personal information and data was kept confidential and used only for research purposes. All data was anonymized and stored securely.

Statistical analysis:

Data was analysed using SPSS (Statistical Package for the Social Sciences version 23). The analysis was involved: Descriptive Statistics: Frequency distribution, means, and standard deviations to summarize demographic characteristics and the prevalence of anemia.

Chi-Square Test: To assess the association between risk factors (such as nutritional habits, socioeconomic status, and comorbidities) and the occurrence of anemia.

Significance Level: A p-value of less than 0.05 was considered statistically significant.

Results:

In our survey, we recruited a total of 350 pregnant mothers. The findings, as given in **Figure (1),** indicated that the prevalence of anemia among these women was rather high, like 76.86% (n=269). On the other hand, 23.14% (n=81) of the women were revealed to be non-anemic.

Table (1) shows the socio-demographic data of the pregnant women attending the antenatal clinics at the Authority of Al-Thawrah general hospital, Hodeidah. Most of the samples were in the age groups (15-34 years), more than one-half of them (176 (50.4%)) were in the age group (15-24 years), while 153 (43.8%) in the age group (25-34 years). Most of the sample were living in the urban districts (262 (75.1%)); The majority of the sample were housewives (315 (90.3%)). More than two thirds of the sample had low income (<50000 Yemeni Rials/month) (248 (71.1%)).

We further characterized the degree of anemia among the affected women in **table 2**. It was graded as mild in 55.7% (n=150) of cases, moderate in 41.6% (n=112) of cases, and severe in 2.6% (n=7) of cases.

Table (3) shows the anemia status and associated obstetrics and gynecological risk factors of the pregnant women attending the antenatal clinics at the Authority of Al-Thawrah general hospital. According to the WHO classification of anemia, more than three-quarters of the sample had anemia (77.1%). Out of them, more than one-half had mild anemia (55.6%). The high prevalence of anemia was in the third trimester of pregnancy (65.6%), as compared to the first, second and third trimesters 49 (14%) 71(20.3%) and 229 (65.6%) respectively.

The majority of the samples did not have an abortion (68.1%) and (88.1%) had no or one cesarean section. Less than half (44.8) of the sample were in the first or second pregnancy. More than two third (69.2%) of the sample had 1-2 years spacing between pregnancies, and less than two third (61.5 %) of the sample weren't taking contraceptive drugs. The majority (88.2%) of the participants had no bleeding during pregnancy. Nearly three-quarters (74.7%) of the sample did not have any medical problem.

Table (4) shows the association between participants' socio-demographics and anemia for the pregnant women attending the antenatal clinics at the Authority of Al-Thawrah general hospital, Hodeidah. The findings of this study revealed that there was no statistically significant association between age, residency, occupation, and level of education and anemia; but there was a statistically significant association between monthly incomes and anemia (P-value = 0.05).

Discussion

The findings of this study, with a high prevalence of anemia (76.8%) among pregnant women in Hodeidah, Yemen, are a clear indication of a widespread public health concern **(Al-Alimi et al., 2018).** This rate is significantly higher than previous reports from Yemen and neighboring countries like Ethiopia, Sudan, and Nigeria, which reported anemia prevalence rates ranging from 40%

to 60% among pregnant women (**Hwalla et al., 2017)**.

The difference can be attributed to variations in socioeconomic conditions, access to healthcare, and the ongoing humanitarian crisis in Yemen, which exacerbates malnutrition and healthcare service disruptions. This study agrees with **(Al-Farsi et al., 2011)** conducted in Taiz, Yemen found a prevalence of (61%) anemia among pregnant women, this study disagree with **(Bukhari et al., 2020)** that found prevalence of 31.2% among pregnant women.

In this study women who had one or more cesarean deliveries showed a higher likelihood of developing anemia (OR=4.31). This may be due to the increased blood loss associated with surgical delivery. Additionally, women who experienced antepartum hemorrhage were also at a significantly higher risk (OR=6.07), further emphasizing the need for close monitoring and intervention in high-risk pregnancies
Similarly, a study in Sudan highlighted cesarean deliveries and advanced pregnancy as predictors of anemia **(Adam et al., 2018)**, which corresponds to your results that cesarean deliveries and third-trimester pregnancies were linked to higher anemia rates.

One surprising finding was the protective effect of combination hormonal contraceptives (CHC) against anemia (OR=0.36, p=0.006). suggesting that CHC users experience less menstrual blood loss, thus conserving iron stores and reducing the risk of anemia. Expanding access to family planning services, including CHC, could be a valuable strategy in reducing anemia prevalence among women of reproductive age.

A study from India found no significant association between inter-pregnancy intervals and anemia **(Patel et al., 2018)**, which contrasts with your finding that shorter intervals increase anemia risk. The disparity may reflect differences in family planning education and healthcare systems between regions.

Conclusion

The incidence of anemia among expecting mothers in Hodeidah, Yemen, is dangerously high, with a rate of 76.86%, which is much higher than earlier studies from Yemen and surrounding countries. This highlights the essential necessity for action to tackle this situation.

Many risk factors for anemia in expecting women have been discovered. Advanced gestational age, greater gravidity, shorter inter-pregnancy intervals, and fewer prenatal care visits have all been linked with an increased risk of anemia.

The protective effect between the users of combination hormonal contraceptives against anemia was surprising, with possibly increasing iron status. This shows that boosting expansion in family planning services, particularly the supply of hormonal contraceptives, might have a role in lowering the incidence of anemia among pregnant women.

Women with 1-2 pregnancies are more prone to anemia compared to those with more pregnancies. This underscores the need for focused assistance and treatments for women throughout their first and second pregnancies to prevent and manage anemia **(Karami et al., 2022).** Furthermore, the frequency of prenatal care visits is also a major predictor in the incidence of anemia. Women with less prenatal care visits had greater increase incidence of anemia, and variables like as cost, accessibility, and education may impact the usage of antenatal care services.

Also, we found there was no statistically significant association between age, residency, occupation, and level of education and anemia; but there was a statistically significant association between monthly incomes and anemia (P-value = 0.05). Furthermore, focused treatments for women over 30 and improved family planning assistance can reduce anemia rates even more, enhancing the health of mothers and newborns.

Recommendations

The result of this study suggests the following recommendations:

1. Similar studies should be conducted in the future and are needed on the prevalence of anemia at other hospitals in Hodeidah, Yemen.
2. A regular review of factors which may contribute to the prevalence of maternal anemia be undertaken in future.
3. Pregnant women as well as adolescent girls should be provided health education about the importance of anemia free pregnancy.
4. Motivation towards early detection and management of anemia in pregnancy should be given to the antenatal care providers.
5. Services of extension nutritionists in an integrated program should be enlisted by government of Hodeidah for the management of anemia in pregnant women.

Figure (1): Prevalence of anemia among pregnant women

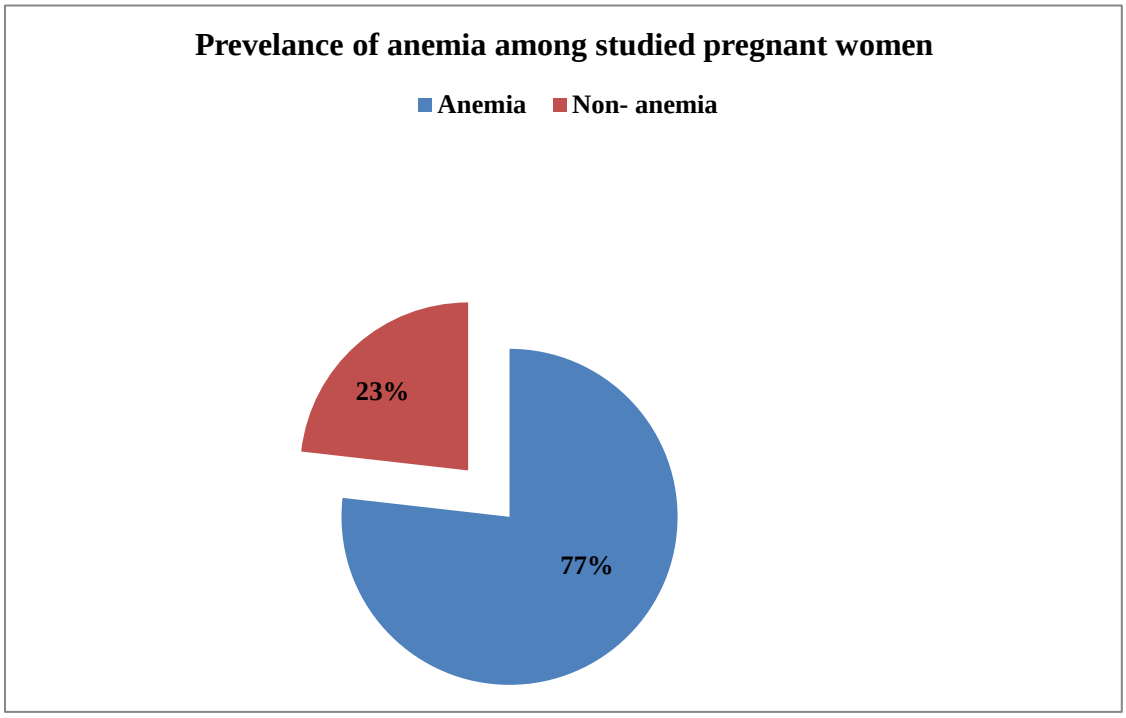

Table (1): Sociodemographic data of the pregnant women attending the antenatal clinics at The Authority of Al-Thawrah general hospital

Variable		Frequency	(%)
Age (Years)	15-24 years	176	(50.4)
	25-34 years	153	(43.8)
	35-43 years	20	(5.7)
Residency	Rural	87	(24.9)
	Urban	262	(75.1)
Occupation	Housewife	315	(90.3)
	Student	12	(3.4)
	Public/Private Employee	22	(6.3)
Level of education	Illiterate or not regular education	90	(25.8)
	Primary	56	(16.0)
	Middle	73	(20.9)
	Secondary	83	(23.8)
	Graduate/Postgraduate	47	(13.5)
Incomes in Yemeni Rial	Low <50000	248	(71.1)
	Moderate to Low: 50000 - 100000	95	(27.2)
	Moderate to Low: 100000 - 200000	5	(1.4)
	< High income>200000	1	(0.3)

Table (2): Severity of anemia symptoms among anemic participants

Severity of Anemia Symptoms	Mild	Moderate	Severe	Total	Prevalence (%)
Anemia Symptoms	150	112	7	269	100%
Prevalence (%)	55.7%	41.6%	2.6%	100%	

Table (3): Anemia status and associated obstetrics and gynecological risk factors of pregnancy.

Variable		Frequency	(%)
Anemia	Yes	269	(77.1)
	No	80	(22.9)
Severity of anemia	Mild:10-11 g/dl	150	(55.6)
	Moderate: 7-9.9 g/dl	112	(41.4)
	severe: <7 g/dl	7	(3.0)
Gestational age trimester	First Trimester: 1-3 month	49	(14.0)
	Second Trimester:3-6	71	(20.3)
	Third Trimester:6-9	229	(65.6)
Number of pregnancies	1- 2	156	(44.8)
	3-4	92	(26.4)
	5 or more	100	(28.7)
Parity	1- 2	130	(49.8)
	3-4	77	(29.5)
	5 or more	54	(20.7)
Number of children	First Gestational	89	(26.9)
	1-2 children	136	(41.1)
	3-4 children	66	(19.9)
	5 or more	40	(12.1)
Abortion	Yes	111	(31.9)
	No	237	(68.1)
Number of cesarean sections	0-1	303	(88.1)
	2 or more	41	(11.9)
Spacing between pregnancies	1- 2 Years	184	(69.2)
	3-4 Years	59	(22.2)
	5 or more years	23	(8.6)
	No	214	(61.5)
Type of contraceptive	CHC	60	(26.9)
	Single	41	(18.4)
	Injection	6	(2.7)
	IUD	21	(9.4)
	Implant	10	(4.5)
	NO	85	(38.1)
Bleeding during pregnancy	Yes	41	(11.8)
	No	307	(88.2)
Medical history	No medical problem	261	(74.7)
	Cardiovascular disease	57	(16.3)
	Renal disease	19	(5.4)
	Respiratory disease	13	(3.6)
Folic Acid	Yes	212	(60.7)

	No	137	(39.3)
Folic Acid duration	less than month	73	(33.5)
	1-2 months	51	(23.4)
	> 3 months	94	(43.1)
Iron	Yes	107	(30.7)
	No	241	(69.3)
Iron duration time	less than month	45	(41.3)
	1-2 months	34	(31.2)
	> 3 months	30	(27.5)

Table (4): Association between participants' sociodemographic and anemia for the pregnant women

Variable		Anaemia				X^2	p-value
		Yes		No			
		Frequency	(%)	Frequency	(%)		
Age	15-24 years	143	(53.2)	33	(41.3)	3.602	0.17
	25-34 years	112	(41.6)	41	(51.3)		
	35-43 years	14	(5.2)	6	(7.5)		
Residency	Rural	73	(27.1)	14	(17.5)	3.060	0.08
	Urban	196	(72.9)	66	(82.5)		
occupation	housewife	243	(90.3)	72	(90.0)	0.502	0.80
	Student	10	(3.7)	2	(2.5)		
	Public/Private Employee	16	(5.9)	6	(7.5)		
level of education	illiterate or not regular education	66	(24.5)	24	(30.0)	2.118	0.70
	Primary	41	(15.2)	15	(18.8)		
	Middle	59	(21.9)	14	(17.5)		
	Secondary	66	(24.5)	17	(21.3)		
	graduate/postgraduate	37	(13.8)	10	(12.5)		
Incomes (Yemeni Rial)	low <50000	190	(70.6)	58	(72.5)	7.415	**0.05***
	Moderate: 50000 - 100000	79	(29.4)	22	(27.5)		

*** Statistically significant (p<0.05)**

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