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Original Research Article

Optimizing maternal and neonatal health: a review of anemia at term pregnancy

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ABSTRACT

Background: Anemia in pregnancy remains a critical global health issue, particularly in developing countries, leading to significant maternal and fetal complications. The study aimed to identify factors contributing to anemia at term and its impact on maternal and neonatal outcomes.
Methods: A prospective observational study was conducted at a tertiary hospital in (Mumbai), including 100 pregnant women with hemoglobin <11 gm/dl at term (≥37 weeks) who fulfilled the inclusion and exclusion criteria. Demographics, antenatal care practices, and outcomes were analyzed using a predesigned case record proforma.
Results: The prevalence of mild anemia was 79%, while 21% had moderate anemia. Poor dietary intake, non-compliance with oral iron therapy, and low socioeconomic status were significant contributors. Anemia at term predisposed women to increased risks of labor complications, including prolonged hospital stays and a higher need for parenteral iron therapy or blood transfusions. Neonatal complications, including low APGAR scores and NICU admissions, were higher among moderately anemic mothers.
Conclusions: Anemia at term leads to adverse maternal and neonatal outcomes. Strengthening antenatal care, improving dietary practices, and ensuring adherence to supplementation can mitigate the risks associated with anemia.

Keywords: Adherence to oral hematinics, Anemia at term, Maternal outcomes, Neonatal outcomes, Pregnancy

INTRODUCTION

Anemia in pregnancy is a serious global health issue and remains an important public health problem in under developed and developing countries and is associated with number of maternal and fetal complications. The condition is prominent in southeast-Asian countries where about half of all global maternal deaths are due to anemia.

Definition of anemia

The World Health Organization (WHO) defines anemia in pregnancy as hemoglobin values less than 11 gm/dl. Center of Disease Control (CDC), however, defines anemia as pregnancy hemoglobin less than 11 gm/dl [hematocrit; (HCT)\33%] in the first and third trimester and less than 10.5 gm/dl (HCT\32%) in the second trimester. Anemia in postpartum females is defined as hemoglobin less than 10 gm/dl by WHO.[1,2] Hemoglobin cutoff in pregnancy anemia as defined by WHO, thus are different Trimesters (Table 1), Indian Council of Medical Research considers hemoglobin (Hb) level between 10 to 10.9 gm/dl as mild anemia, moderate anemia as hemoglobin between 7 to 10 gm/dl, severe when hemoglobin is less than 7 and very severe when its <4 gm/dl.[3-5]

Table 1: Hemoglobin cutoff in pregnancy anemia.[3]

Pregnancy state	Normal (gm/dl)	Mild (gm/dl)	Moderate (gm/dl)	Severe (gm/dl)
First trimester	11 or higher	10-10.9	7-9.9	<7
Second trimester	10.5 or higher			
Third trimester	11 or higher	10-10.9	7-9.9	<7

Prevalence of anemia

India accounts for approximately 80% of maternal deaths due to anemia in Southeast Asia. According to World Health Organization (WHO) data from 2016, 40.1% of pregnant women worldwide were anemic.[6] In India, there has been a marginal decline in the prevalence of anemia among pregnant women, from 58% in the NFHS-3 survey (2005-06) to 50% in NFHS-4 (2015-16). This decline reflects the positive impact of a two-pronged strategy: increasing iron intake through dietary diversification and iron-fortified iodized salt, along with screening, early detection, and treatment of anemia during pregnancy. However, according to the most recent National Family Health Survey (NFHS-5) conducted in 2019-21, the prevalence of anemia among pregnant women (15-49 years) has risen to 52.2%, indicating a reversal of the previous declining trend.[7] The factors predisposing to occurrence of anemia in pregnancy vary from the person behaviors to community attributes. Socioeconomic factors, cultural factors, nutritional status, diet, infections, and parasitic infestations all contribute to a varied degree to occurrence of anemia.

Socioeconomic factors

Anemia in pregnant women living in developing countries, Socio-economic deprivation which has been linked with the development, severity, and outcome of many medical conditions and is an overlooked factor.[8,9] In addition, lack of education and understanding about health-related issues can contribute to delays in seeking care when it is needed or to the inappropriate management of life-threatening pregnancy complications.[10,11]

In tropical countries, deficiency of both iron and folic acid deficiency which is seen is directly associated with poor health status, poverty, poor socioeconomic status, multiparity and less birth spacing.[7,11]

Consequence of anemia in pregnancy

Anemia is considered as an indicator of both poor nutrition and impaired health for women in general and particularly more adversely affecting the reproducing women.[12] The negative health effects for mothers due to anemia include fatigue, poor work capacity, decreased quality of life, including increased tiredness, breathlessness, palpitations, impaired immune function, increased risk of cardiac disease and mortality.[7,12,13] Anemia in pregnancy at term and delivery increases the risk of labor complications, complicated delivery, postpartum hemorrhage and also increases the risk of infection to both mother and developing fetus, thus increases risk of maternal morbidity and mortality.[7,12-17] Low birth weight and adverse birth outcome, neonatal sepsis increases risk of perinatal mortality.[16,17] These are the prominent consequences of anemia in pregnancy in most developing countries, particularly in southeast Asia.

Despite the advancing knowledge in obstetric technology, achievements in Maternal and Child Health (MCH) related issues, MCH and nutritional awareness programs (I-NIPI = Intensified National Iron Plus Initiative, Anemia Mukt Bharat) initiated by government of India to improve nutritional status, anemia in pregnancy is still widely prevalent in India.

Anemia has hazardous influence on maternal and fetal outcome and increases risk of postpartum hemorrhage (PPH), infection, sepsis and risk for preterm birth, low birth weight and small for gestational age babies, increased risk of intrauterine deaths (IUFD), low APGAR score at 5 minutes of birth and intrauterine growth restrictions (IUGR) which is a risk factor for stunting among the children of less than 2 years there by contributing to maternal and perinatal morbidity and sometimes mortality.[18]

In spite of awareness and management of anemia once pregnancy is detected, a significant proportion of women yet reach term (37 weeks gestation) with anemia. This increases the risk of maternal morbidity and mortality. Also, it presents dilemmas in management as there is very little time available for correcting anemia before labor sets in, thus increasing the need for blood transfusions before and after delivery.

In view of these, the present study was planned and conducted to review the cases of anemia at term and study the factors responsible for a woman reaching term with anemia and also study the maternal and fetal outcome so as to be able to implement better strategies in the antenatal period to avoid a woman reaching term with uncorrected anemia.

METHODS

The present study was a prospective observational study conducted among pregnant women presenting to the Obstetric ward, managed by the department of obstetrics and gynecology at Nowrosjee Wadia Maternity Hospital a

teaching hospital affiliated with Seth G. S. Medical College and KEM Hospital, Parel, Mumbai, Maharashtra, India. The study was conducted during the period from September 2021 to December 2022 and included women beyond 37 weeks of gestation who met the specified inclusion and exclusion criteria. Necessary approvals were obtained from the ethics committee- Seth G. S. Medical College and KEM Hospital and the professor and head of the Department of Obstetrics and Gynecology before initiating the study.

Patients eligible for inclusion were those with hemoglobin levels below 11 gm/dl and admitted either in labor or for antenatal evaluation. However, patients with anemia due to antenatal blood loss, such as in cases of abruptio placentae, those diagnosed with anemia in the postpartum period, and individuals with thalassemia or other hemoglobinopathies were excluded.

Additionally, patients unwilling to participate in the study were not considered. Eligible patients were enrolled after providing written informed consent. The study objectives and procedures were explained in a language they understood, and all their queries were addressed. Participants were then interviewed using a pre-designed case record proforma.

Data collection

A detailed history was taken for each participant, covering various demographic and clinical aspects. Information was collected on age, literacy level, and socioeconomic status, assessed using the modified Kuppuswamy scale. The booking status of the pregnancy and compliance with oral hematinics were also evaluated. Additionally, a history of any antenatal admissions or complications was recorded, along with any prior administration of intravenous iron therapy or blood transfusions. A comprehensive obstetric and menstrual history was obtained, including details of previous pregnancies and menstrual patterns. Past surgical and medical history was reviewed, with particular attention to the inter-pregnancy interval and the presence of any chronic medical illnesses.

Investigations

The study involved a series of investigations to assess maternal anemia and its impact. A complete hemogram and peripheral blood smear were performed for all participants. Serum iron, ferritin, total iron-binding capacity, percentage of transferrin saturation, and hemoglobin electrophoresis were conducted in selected patients to evaluate iron status and rule out hemoglobinopathies. Additionally, urine routine examination, microscopy, and culture sensitivity were performed to detect any underlying infections. Obstetric ultrasound was used to assess fetal outcomes. Additional investigations were carried out as required based on clinical indications. Patients were induced based on obstetric indications to ensure optimal maternal and fetal outcomes. The study included anemic pregnant women with a gestational age of more than 37 weeks, who were further classified according to the WHO definition. Data collection focused on demographic and antenatal factors in the current pregnancy, along with maternal and fetal outcomes associated with anemia.

RESULTS

The study enrolled 100 pregnant women with term gestation (≥37 weeks) and hemoglobin levels <11 gm/dl. Their demographic and clinical data were analyzed to understand the factors contributing to anemia at term and its impact on maternal and neonatal outcomes. The findings are summarized below:

Demographics and antenatal history

Age and education: a majority of the women (88%) were homemakers, and only 7% had completed graduation. Most patients had an intermediate level of education (62%).

Socioeconomic status: all participants were from the middle-class category, with 45% belonging to the lower middle class and 55% to the upper middle class. However, this was not statistically significant, possibly due to the small sample size (Table 2).

Dietary patterns: mixed diets (vegetarian and non-vegetarian) were common (86%), while 7% followed a strictly vegetarian diet. Among vegetarians, 71.4% had moderate anemia, indicating a significant association between dietary practices and anemia severity. The following table summarizes the association between diet types and term anemia (Table 3).

Parity and antenatal registration: primigravida accounted for 51% of cases. Antenatal care registration in the first trimester was noted in 64% of cases, while 36% registered in the second trimester. Early registration was associated with better anemia management.

Adherence to oral hematinics: non-adherence to oral iron supplements was observed in 37% of participants, correlating with higher rates of moderate anemia.

Hematological and ultrasound findings

Anemia severity: mild anemia was predominant (79%), while 21% had moderate anemia. Severe anemia, when diagnosed early in pregnancy and treated antenatally, often results in patients transitioning to less severe categories by the time they reach term. This underscores the importance of early diagnosis and timely intervention to mitigate the impact of anemia on maternal and neonatal outcomes.

Postpartum anemia: following delivery, moderate anemia was observed in 69.8% of cases, mild anemia in 29.2%, and severe anemia in 1%.

Ultrasound findings showed most pregnancies (82%) resulted in appropriately grown fetuses (AGA), while 14% had small-for-gestational-age (SGA) fetuses. SGA prevalence increased with anemia severity (Table 4).

Table 2: Antenatal and obstetric history of the patients (n=100).

Variables		No.	Percentage
Age (in years)	19 to 23	9	9.0
	24 to 28	33	33.0
	29 to 33	41	41.0
	34 and more	17	17.0
Parity	Primigravida	51	51.0
	Multigravida	49	49.0
Trimester of pregnancy at 1st visit	1st	64	64.0
	2nd	36	36.0
Anemia history in antenatal	Yes	40	40.0
	No	60	60.0
Diet	Diabetic diet	7	7.0
	Vegetarian	7	7.0
	Mixed	86	86.0
Adherence to oral hematinics	Adherent	63	63.0
	Non-adherent	37	37.0

Table 3: Association among the patients between type of diet and term anemia.

Type of Diet		Term anemia		Total
		Moderate anemia	Mild anemia	
Diabetic diet^	No.	2	5	7
	%	28.6	71.4	100.0
Vegetarian^	No.	5	2	7
	%	71.4	28.6	100.0
Mixed	No.	14	72	86
	%	16.3	83.7	100.0
Total	No.	21	79	100
	%	21.0	79.0	100.0
Chi-square tests	**Value**	**Df**	**P value**	**Association is-**
Pearson Chi-Square $	12.127	2	0.0023	Significant
Pearson Chi-Square ^	6.345	1	0.012	Significant
Fisher's Exact Test ^			0.009	Significant

$ 2 cells (33.3%) have expected count less than 5. ^ Row data pooled, and chi-square test reapplied with continuity correction. ^ 1 cell (25.0%) has expected count less than 5. P value of Fisher's exact test was used.

Table 4: Distribution of hematological variables and USG finding among the patients.

Variables		No.	Percentage (n=100)
Term anemia status	Severe anemia	0	0
	Moderate anemia	21	21.0
	Mild anemia	79	79.0
Post-delivery hemoglobin anemia status	Severe anemia	1	1.0
	Moderate anemia	67	69.8
	Mild anemia	28	29.2
Latest ultrasound scan	AGA	82	82.0
	SGA	14	14.0
	LGA	4	4.0

Continued.

Variables		No.	Percentage (n=100)
Need for i.v. iron therapy/need for blood transfusion	Double oral iron	83	83.0
	Injection FCM 1 gm i.v.	9	9.0
	Injection FCM 1 gm i.v., injection vitcofol	7	7.0
	PRBC transfusion	1	1.0

Table 5: Association among the patients between term anemia and need for i.v. iron therapy or blood transfusion.

Need for i.v. iron therapy/need for blood transfusion		Term anemia		Total
		Moderate anemia	Mild anemia	
Double oral iron	No.	12	71	83
	%	57.1	89.9	83.0
Injection FCM 1 gm i.v.	No.	4	5	9
	%	19.0	6.3	9.0
Injection FCM 1 gm i.v., injection vitcofol	No.	4	3	7
	%	19.0	3.8	7.0
PRBC transfusion	No.	1	0	1
	%	4.8	0.0	1.0
Total	No.	21	79	100
	%	100.0	100.0	100.0
Chi-square tests	**Value**	**Df**	**P value**	**Association is-**
Pearson chi-square $	14.397	3	0.00241	Significant
Pearson chi-square ^	10.383	1	0.00127	Significant
Fisher's exact test ^			0.00132	Significant

$ 4 cells (50.0%) have expected count less than 5. ^ Row data, except first row, pooled and chi-square test reapplied with Continuity Correction. ^ 1 cell (25.0%) has expected count less than 5. P value of Fisher's exact test was used.

Maternal and neonatal outcomes

Maternal morbidity: moderate anemia was associated with a higher requirement for intravenous iron therapy (16%) and blood transfusion (1%). Post-delivery hemoglobin levels showed significant reductions in patients with moderate anemia, necessitating prolonged hospital stays. (Table 5).

Mode of delivery: the severity of anemia influenced labor and delivery, with moderate anemia cases experiencing a higher operative intervention.

Neonatal outcomes: NICU admissions were more frequent among neonates of moderately anemic mothers (35.8%). Poor APGAR scores at birth and 5 minutes were also more common in this group.

DISCUSSION

Anemia in pregnancy continues to be a major public health issue, particularly in India, where nutritional deficiencies, socio-economic disparities, and gaps in antenatal care contribute to its high prevalence. Our study aimed to assess anemia in term pregnancy, focusing on its impact on maternal and neonatal health, and the role of demographic and obstetric factors in its severity and outcomes.

Demographic and socioeconomic influences

In our study, most participants were homemakers, with 62% having completed an intermediate level of education and only 7% having attained graduation. While all participants belonged to the middle-class category, anemia prevalence did not significantly differ based on socioeconomic status. This contrasts with prior studies that have reported a higher prevalence of anemia among lower socioeconomic groups.[10] The discrepancy in our findings could be attributed to the relative homogeneity of our sample.

Dietary patterns and adherence to iron supplementation

Our study found a significant association between dietary patterns and anemia severity. While most participants consumed a mixed diet, those following a vegetarian diet had a higher prevalence of moderate anemia (71.4%), suggesting inadequate iron intake from vegetarian sources. This aligns with findings from Stephen et al, which reported that inadequate dietary iron intake was a major contributor to anemia in pregnancy.[13]

Furthermore, 37% of participants were non-adherent to oral hematinics, correlating with higher rates of moderate anemia. Similar trends were observed in Jasti et al study,

which highlighted poor adherence to iron supplementation among low-income women due to gastrointestinal side effects and misconceptions.[20] Improving compliance through patient education and alternative iron supplementation methods, such as intravenous therapy for intolerant individuals, could help reduce anemia severity.

Maternal and neonatal outcomes

Our findings confirm that anemia significantly impacts both maternal morbidity and neonatal health. Moderate anemia was associated with an increased need for intravenous iron therapy (16%) and blood transfusion (1%). Postpartum hemoglobin levels showed a significant decline, leading to prolonged hospital stays. These results are consistent with prior research linking anemia to a higher risk of postpartum hemorrhage (PPH), infections, and delayed recovery.[17]

In terms of neonatal outcomes, small-for-gestational-age (SGA) fetuses were observed in 14% of cases. Studies indicate that maternal anemia increases the risk of fetal growth restriction due to impaired oxygen and nutrient transport to the placenta.[15] Additionally, neonates born to moderately anemic mothers had higher NICU admission rates (35.8%) and lower APGAR scores, reinforcing the long-term implications of maternal anemia on neonatal health.[11]

Mode of delivery and birth complications

The severity of anemia was found to influence labor and delivery outcomes. Cases of moderate anemia had a higher rate of operative interventions, which is in line with previous studies that reported an increased risk of cesarean delivery due to fetal distress and labor complications.[12]

CONCLUSION

Anemia in term pregnancy remains a critical health challenge, but with early diagnosis, proper antenatal care, and effective intervention strategies, its impact can be significantly reduced. Our study highlights the importance of early antenatal registration, adherence to iron supplementation, and dietary modifications in managing anemia and improving both maternal and neonatal outcomes. Encouragingly, most cases of anemia at term were mild, reinforcing the effectiveness of timely interventions. With continued efforts in patient education, better compliance with iron therapy, and strengthened nutritional programs, the burden of anemia can be further minimized. A multidisciplinary approach that includes healthcare providers, policymakers, and community engagement can ensure healthier pregnancies and better neonatal outcomes. By prioritizing maternal nutrition and proactive anemia management, we can contribute to a future where every pregnancy is safer and every newborn has a healthier start in life.

Recommendations

Improving preconceptional and antenatal iron status through nutritional counselling, education, and adherence to supplementation regimens is crucial. Education has emerged as a significant predictor of non-compliance with iron and folic acid (IFA) supplementation. Personal interactions with enrolled patients revealed that the most common causes of non-compliance included forgetfulness, gastrointestinal side effects, worries about weight gain, and inadequate information about the therapy duration. Gastrointestinal side effects such as nausea, flatulence, abdominal pain, constipation, and diarrhea can be reduced by adjusting the dose, changing the form of iron salts, or advising pregnant women to take IFA supplements after dinner and before sleeping.[23]

Pregnant women on oral iron supplements should also be counselled to consume IFA tablets before meals or at least one hour after meals, along with vitamin C supplements or foods rich in vitamin C (e.g., lemon in the form of nimbu-paani, amla) to enhance absorption. Avoiding tea or coffee within an hour of consuming IFA and maintaining a two-hour gap between calcium and iron tablets are additional measures that can improve compliance and effectiveness.[23]

Worm infestation, particularly hookworm infestation, along with nutritional deficiency, is an important cause of anemia. Deworming with one dose of 400 mg albendazole (1 tablet) after the first trimester, preferably during the second trimester, is an effective intervention for anemia prophylaxis.[23]

Incorporating iron-rich foods such as meat, fish, eggs, poultry, green leafy vegetables (e.g., mustard, fenugreek, bathua, amaranth, radish leaves), whole pulses (e.g., Bengal gram, horse gram), and cereals (e.g., whole wheat flour, bajra, ragi, jowar) is essential. Including vitamin C-rich foods like fruits (e.g., gooseberry, guava, lemon, orange, raw mango), vegetables (e.g., drumstick leaves, capsicum), and sprouts in the diet can further improve iron absorption and prevent anemia.[23]

Utilizing general healthcare services, such as family planning, significantly reduces anemia by increasing the gap between pregnancies and achieving lower parity. Pregnant women with iron-deficiency anemia (IDA) in the third trimester are more likely to benefit from intravenous (i.v.) iron. If symptomatic with severe anemia, pregnant women may require blood transfusion. Prophylactic antibiotics can also be administered in the postpartum period to prevent sepsis.

Limitations

This study was conducted at a single center and included only term pregnancies (≥37 weeks) with 100 study sample. Further multicentric studies are warranted to generalize the

findings and explore anemia's impact across different gestational ages.

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