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Clinicohematological Profile of Anemia in Pregnant Women Attending a Tertiary Care Hospital - Prevalence and Severity

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Abstract

Background: Anemia in pregnancy remains one of the most prevalent nutritional and hematological disorders in developing countries and is associated with adverse maternal and fetal outcomes. Characterizing the Clinicohematological profile of anemic pregnant women helps identify the underlying etiology, including hemolytic causes, and guides appropriate management.

Objectives: To determine the prevalence and severity of anemia among pregnant women attending the antenatal clinic of a tertiary care hospital and to describe the Clinicohematological profile, including morphological typing and identification of hemolytic anemia.

Materials and Methods: A hospital-based cross-sectional study was conducted over 12 months among 400 pregnant women attending the antenatal outpatient department. Hemoglobin estimation, complete blood counts, red cell indices, peripheral smear examination, reticulocyte count, and, where indicated, serum ferritin, sick ling test, and hemoglobin electrophoresis were performed. Anemia was defined and graded according to World Health Organization (WHO) criteria.

Results: The overall prevalence of anemia was 58.5% (234/400). Mild, moderate, and severe anemia were observed in 41.9%, 47.4%, and 10.7% of anemic women, respectively. Microcytic hypo chromic anemia (68.4%) was the most common morphological type, followed by normocytic normochromic (17.9%), dimorphic (9.4%), and macrocytic (4.3%) anemia. Hemolytic anemia was identified in 5.1% of anemic women, most commonly due to sickle cell disorders and thalassemia syndromes. Anemia was significantly associated with multiparity, short inter-pregnancy interval, and lower socioeconomic status.

Conclusion: Anemia, predominantly iron deficiency, is highly prevalent among pregnant women in this setting, with a small but clinically important subset attributable to hemolytic disorders. Routine hematological workup with peripheral smear examination is essential for accurate etiological diagnosis and targeted therapy.

Keywords: Anemia in Pregnancy, Prevalence, Severity, Clinicohematological Profile, Hemolytic Anemia, Iron Deficiency

Introduction

Anemia is the most common hematological disorder encountered in pregnancy and constitutes a major public health problem, particularly in low- and middle-income countries. The World Health Organization (WHO) defines anemia in pregnancy as a hemoglobin (Hb) concentration below 11 g/dL and further grades its severity as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), and severe (<7.0 g/dL)[1.] Globally, an estimated 37–40% of pregnant women are anemic, with the burden disproportionately concentrated in South Asia and sub-Saharan Africa[2,3]. In India, national surveys have consistently reported alarmingly high figures; the National Family Health Survey-5 (NFHS-5) documented that more than half of Indian pregnant women aged 15–49 years are anemic[4], and earlier community-based studies reported prevalence rates as high as 84% in some regions[5].

The physiological changes of pregnancy contribute substantially to the development of anemia. Plasma volume expands by 40–50% while red cell mass increases by only 20–30%, resulting in hemo dilution and a physiological fall in hemoglobin concentration [6]. Superimposed on this physiological state are the markedly increased demands for iron, folic acid, and vitamin B12 required for fetoplacental growth and expansion of maternal red cell mass. Iron deficiency remains the leading cause of anemia in pregnancy worldwide, accounting for the majority of cases, followed by folate and vitamin B12 deficiency, chronic infections such as malaria and hookworm infestation, and inherited hemolytic disorders including thalassemias and hemoglobino pathies [7,8].

The consequences of anemia in pregnancy are far-reaching. Maternal effects include impaired work capacity, increased susceptibility to infection, cardiac decompensation in severe cases, and a heightened risk of postpartum hemorrhage and maternal mortality[9]. Anemia is estimated to contribute directly or indirectly to a substantial proportion of maternal deaths in developing countries[5,9]. Fetal and neonatal consequences include intrauterine growth restriction, preterm birth, low birth weight, and increased perinatal mortality[10,11]. Moreover, maternal iron deficiency may compromise neonatal iron stores and subsequent neuro cognitive development of the infant [11].

While nutritional deficiency dominates the etiological spectrum, hemolytic anemia's form an important, frequently under - recognized subgroup in antenatal populations, particularly in regions where sickle cell disorders, thalassemia syndromes, and glucose – 6 - phosphate dehydrogenase (G6PD) deficiency are prevalent [12,13].

Hemolytic anemia in pregnancy poses unique diagnostic and therapeutic challenges: it may mimic or coexist with iron deficiency, may be aggravated by the oxidative and hemodynamic stresses of pregnancy, and inappropriate iron supplementation in iron-loaded hemolytic states may be harmful[13].

A systematic Clinicohematological evaluation - encompassing red cell indices, peripheral smear

morphology, reticulocyte count, and confirmatory tests such as hemoglobin electrophoresis—therefore remains indispensable for accurate etiological classification [14].

Despite universal antenatal iron – folic acid supplementation programs, the prevalence of anemia in pregnancy in India has declined only marginally, suggesting gaps in coverage, compliance, and etiological targeting of therapy[4,5].

Tertiary care hospitals, which receive both booked and referred high-risk pregnancies, offer an appropriate setting to study the true spectrum and severity of anemia. The present study was therefore undertaken to determine the prevalence and severity of anemia among pregnant women attending a tertiary care hospital and to delineate their Clinicohematological profile, with particular attention to the identification of hemolytic anemia.

Materials and Methods

Study design and setting

This hospital-based cross-sectional observational study was conducted in the Department of Pathology in collaboration with the Department of Obstetrics and Gynaecology of a tertiary care teaching hospital over a period of 12 months (January to December).

Study population

All pregnant women attending the antenatal outpatient department during the study period were considered for inclusion. Women of any gestational age and parity who provided written informed consent were enrolled consecutively. Women with a history of blood transfusion within the preceding three months, known bleeding disorders, ante partum hemorrhage at presentation, chronic renal or liver disease, or malignancy were excluded, as these conditions independently alter hematological parameters.

Sample size

Assuming an expected prevalence of anemia of 55% based on previous regional studies, with an absolute precision of 5% and a 95% confidence level, the minimum required sample size was calculated to be 381; a total of 400 women were enrolled to account for incomplete data.

Ethical considerations

The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants, and confidentiality of data was maintained throughout.

Data Collection

A structured proforma was used to record socio demographic details (age, residence, socioeconomic status by modified Kuppuswamy scale, dietary habits), obstetric history (gravidity, parity, inter-pregnancy interval, gestational age), and clinical features (pallor, icterus, gloss it is, koilonychias, splenomegaly, hepatomegaly, and symptoms such as fatigue, breathlessness, and palpitations).

Laboratory methods

Under aseptic precautions, 3 mL of venous blood was collected in an EDTA vacutainer and 2 mL in a plain tube. Complete blood counts, including hemoglobin, red blood cell count, hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), total leukocyte count, and platelet count, were performed on an automated hematology analyzer, with daily internal quality control. Peripheral blood smears were stained with Leishman stain and examined by two pathologists independently for red cell morphology, anisopoikilocytosis, polychromasia, target cells, sickle cells, spherocytes, and

hemo parasites. Reticulocyte count was performed using supravital staining with new methylene blue. In women with clinical or morphological suspicion of hemolysis (icterus, splenomegaly, polychromasia, raised reticulocyte count, or abnormal red cell shapes), additional tests were performed as indicated: serum bilirubin (indirect fraction), lactate dehydrogenase, direct Coombs test, sickling test, and hemoglobin electrophoresis/high-performance liquid chromatography (HPLC). Serum ferritin was estimated in micro cytic anemia to distinguish iron deficiency from thalassemia trait.

Definitions

Anemia was defined as Hb <11 g/dL and graded as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), and severe (<7.0 g/dL) as per WHO criteria [1]. Morphological typing was based on red cell indices and peripheral smear findings. Hemolytic anemia was diagnosed on the basis of reticulocytosis with indirect hyper bilirubinemia and/or confirmatory tests (positive sickling test, abnormal HPLC pattern, or positive direct Coombs test).

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 25.0. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± standard deviation. The chi-square test was used to assess associations between anemia and categorical variables; $p < 0.05$ was considered statistically significant.

Results

A total of 400 pregnant women were studied, of whom 234 were anemic, giving an overall prevalence of 58.5%. The mean age of participants was 25.4 ± 4.2 years, and the mean hemoglobin of anemic women was 9.1 ± 1.4 g/dL.

Table 1: Prevalence and severity of anemia among study participants (N = 400)

Category	Hemoglobin (g/dL)	Number (n)	Percentage of anemic (%)	Percentage of total (%)
Non-anemic	≥11.0	166	—	41.5
Mild anemia	10.0–10.9	98	41.9	24.5
Moderate anemia	7.0–9.9	111	47.4	27.8
Severe anemia	<7.0	25	10.7	6.2
Total anemic	<11.0	234	100	58.5

Moderate anemia was the most frequent grade, and one in ten anemic women had severe anemia requiring urgent intervention.

Table 2: Sociodemographic and obstetric factors in relation to anemia

Variable	Anemic (n = 234)	Non-anemic (n = 166)	p-value
Age <20 years	38 (16.2%)	14 (8.4%)	0.02
Rural residence	152 (65.0%)	78 (47.0%)	<0.001
Lower socioeconomic status	141 (60.3%)	62 (37.3%)	<0.001
Vegetarian diet	129 (55.1%)	71 (42.8%)	0.01
Multiparity (para ≥2)	118 (50.4%)	52 (31.3%)	<0.001
Inter-pregnancy interval <2 years	96 (41.0%)	38 (22.9%)	<0.001
Third trimester at presentation	131 (56.0%)	74 (44.6%)	0.03

Anemia was significantly associated with teenage pregnancy, rural residence, lower socioeconomic status, vegetarian diet, multiparty, short inter-pregnancy interval, and presentation in the third trimester.

Table 3: Clinical features among anemic women (n = 234)

Clinical feature	Number (n)	Percentage (%)
Pallor	234	100
Easy fatigability	187	79.9
Breathlessness on exertion	92	39.3
Palpitations	64	27.4
Glossitis	41	17.5
Koilonychia	33	14.1
Pedal edema	58	24.8
Icterus	9	3.8
Splenomegaly	11	4.7

Table 4: Hematological parameters of anemic women (n = 234)

Parameter	Mean ± SD
Hemoglobin (g/dL)	9.1 ± 1.4
RBC count (×10⁶/μL)	3.6 ± 0.6
Hematocrit (%)	28.2 ± 4.1
MCV (fL)	74.8 ± 10.6
MCH (pg)	24.1 ± 4.3
MCHC (g/dL)	30.6 ± 2.2
RDW (%)	17.8 ± 2.9
Reticulocyte count (%)	1.6 ± 1.1

The predominant pattern was of microcytosis, hypochromia, and elevated RDW, consistent with iron deficiency.

Table 5: Morphological typing of anemia on peripheral smear (n = 234)

Morphological type	Number (n)	Percentage (%)
Microcytic hypochromic	160	68.4
Normocytic normochromic	42	17.9
Dimorphic	22	9.4
Macrocytic	10	4.3

Table 6: Etiological spectrum with special reference to hemolytic anemia (n = 234)

Etiology	Number (n)	Percentage (%)
Iron deficiency anemia	158	67.5
Combined iron + folate/B12 deficiency (dimorphic)	22	9.4

Megaloblastic anemia	10	4.3
Anemia of chronic disease/infection	32	13.7
Hemolytic anemia	12	5.1
— Sickle cell disorders (HbSS/HbS–β-thalassemia)	5	2.1
— β-thalassemia (trait/intermedia)	4	1.7
— Autoimmune hemolytic anemia (DCT positive)	2	0.9
— Hereditary spherocytosis	1	0.4

Hemolytic anemia accounted for 5.1% of anemic pregnancies. These women more frequently had moderate-to-severe anemia, icterus, splenomegaly, polychromasia on smear, and reticulocytosis (mean reticulocyte count 5.8 ± 2.1%) compared with the non-hemolytic group.

Discussion

The present study documented a high prevalence of anemia (58.5%) among pregnant women attending a tertiary care hospital, a figure concordant with national estimates from NFHS-5 [4] and with earlier Indian studies reporting prevalence rates between 50% and 84% [5,15]. Comparable hospital-based studies from South Asia have similarly reported prevalence in the range of 50–70%, confirming that anemia in pregnancy remains an unresolved public health challenge despite decades of supplementation programs [15,16].

In our cohort, moderate anemia (47.4%) predominated, followed by mild (41.9%) and severe anemia (10.7%). This distribution mirrors that described by Toteja et al. in a multicentric Indian survey, where moderate anemia constituted the largest fraction[5], and underscores the clinical importance of the problem, since moderate and severe anemia carry the greatest risk of adverse maternal outcomes, including postpartum hemorrhage, cardiac failure, and maternal death[9]. The significant associations observed with multiparty, short inter-pregnancy interval, lower socioeconomic status, rural residence, and vegetarian diet are biologically plausible and consistent with prior literature: repeated pregnancies deplete maternal iron stores, while poverty and predominantly cereal-based diets limit intake of bio available heme iron [7,15,16].

Morphologically, Microcytic hypo chromic anemia was the leading pattern (68.4%), and iron deficiency was the single most common etiology (67.5%), in agreement with global data identifying iron deficiency as the cause of the majority of anemia in pregnancy [2,7]. The high mean RDW with low MCV and MCH in our anemic women further supports depleted iron stores. Dimorphic anemia (9.4%) and Megaloblastic anemia (4.3%) highlight the coexistence of folate and vitamin B12 deficiency, reinforcing the rationale for combined iron–folic acid supplementation and consideration of B12 in refractory cases [8,14].

An important finding of this study is the identification of hemolytic anemia in 5.1% of anemic pregnant women, predominantly due to sickle cell disorders and thalassemia syndromes, with occasional autoimmune hemolytic anemia and hereditary spherocytosis. Similar proportions have been described in regions where hemoglobino pathies are endemic [12,13]. Recognition of this subgroup has direct therapeutic implications: pregnant women with thalassemia or sickle cell disease may be iron replete or iron overloaded, and empirical parenteral iron may cause harm; instead, they require

folic acid supplementation, monitoring for hemolytic and vaso-occlusive crises, judicious transfusion support, and partner screening with genetic counseling [13,17]. The presence of icterus, splenomegaly, polychromasia, and reticulocytosis served as reliable Clinicohematological pointers toward hemolysis in our study, emphasizing that careful peripheral smear examination and reticulocyte count remain inexpensive yet powerful diagnostic tools, with HPLC/electrophoresis providing confirmation [14].

Anemia of chronic disease/infection (13.7%) in our series reflects the contribution of urinary tract infections, tuberculosis, and other chronic inflammatory states, which blunt erythropoiesis through hepcidin-mediated iron sequestration [18].

Conclusion

Anemia affects more than half of pregnant women attending this tertiary care hospital, with moderate anemia forming the largest fraction and one in ten anemic women being severely anemic. Iron deficiency, manifesting as Microcytic hypo chromic anemia, remains the dominant etiology; however, hemolytic anemia's—chiefly sickle cell disorders and thalassemia syndromes—constitute a small but clinically significant subset (5.1%) that demands specific diagnosis and management distinct from routine iron therapy. A systematic Clinicohematological approach combining red cell indices, peripheral smear examination, reticulocyte count, and confirmatory tests such as HPLC enables accurate etiological classification. Strengthening early antenatal registration, ensuring compliance with iron–folic acid supplementation, screening for hemoglobino pathies in endemic areas, and addressing modifiable risk factors such as short birth spacing and poor dietary quality are essential to reduce the burden and severity of anemia in pregnancy.

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