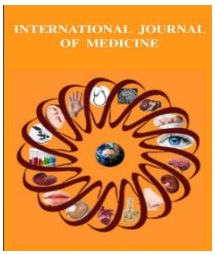

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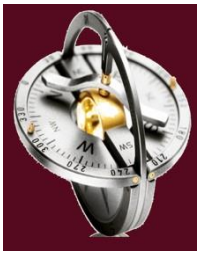

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Original Research

Prevalence and Associated Risk Factors of Anaemia Among Pregnant Women Attending Antenatal Care: A Cross-Sectional Study.

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Abstract

Background: Anaemia remains a frequent nutritional and haematological disorder during pregnancy, particularly in resource-constrained settings, and reflects interacting dietary, socioeconomic, obstetric, and health-service factors. *Objectives:* To determine the prevalence and severity of anaemia and identify associated risk factors among pregnant women attending antenatal care. *Methods:* This hospital-based cross-sectional study included 100 pregnant women attending the antenatal clinic at Government Medical College, Ramagundam, Telangana, India, from November 2024 to October 2025. Sociodemographic, obstetric, nutritional, dietary, and iron-folic acid supplementation data were collected using a structured schedule. Haemoglobin was measured using an automated haematology analyser. Anaemia was defined as haemoglobin below 11.0 g/dL and classified as mild, moderate, or severe. Associations were examined using chi-square tests and logistic regression. *Results:* The mean age was 25.9 ± 4.4 years, and the mean haemoglobin concentration was 10.4 ± 1.4 g/dL. Anaemia was present in 56.0% of participants; 31.0% had mild, 21.0% moderate, and 4.0% severe anaemia. Prevalence increased from 28.6% in the first trimester to 68.0% in the third trimester. In adjusted analysis, lower socioeconomic status (adjusted odds ratio [aOR] 2.47), third-trimester pregnancy (aOR 2.63), underweight status (aOR 2.91), and poor iron-folic acid adherence (aOR 3.41) were independently associated with anaemia. *Conclusion:* Anaemia affected more than half of the antenatal attendees. Strengthened screening, nutrition assessment, adherence counselling, and focused support for socioeconomically vulnerable and underweight women are required throughout pregnancy.

Keywords: *Anaemia; antenatal care; haemoglobin; iron-folic acid; pregnancy; prevalence; risk factors.*

Introduction

Anaemia is a reduction in the oxygen-carrying capacity of blood resulting from an inadequate haemoglobin concentration or red-cell mass. During pregnancy, physiological plasma-volume expansion lowers haemoglobin concentration, while the requirements for iron, folate, vitamin B12, and other nutrients increase to support maternal erythropoiesis, placental development, and fetal growth. Iron deficiency is the dominant nutritional contributor, although inflammation, infection, inherited haemoglobin disorders, parasitic disease, and other micronutrient deficiencies also contribute. The burden is concentrated in low- and middle-income countries, where nutritional deprivation and restricted access to preventive services frequently coexist.[1] Global analyses have shown persistent anaemia among pregnant women despite improvements in maternal health coverage, indicating that routine antenatal attendance alone does not ensure adequate prevention or treatment.[2]

India carries a substantial share of this burden. Analysis of the 2019-2021 National Family Health Survey found anaemia in 52.2% of pregnant women, with higher prevalence among women with limited education, low household wealth, adolescent pregnancy, and short birth intervals.[3] Earlier multicentre data from 16 Indian districts documented marked geographical variation and a high proportion of moderate and severe disease.[4] A national review likewise described anaemia as a longstanding maternal health challenge linked with inadequate dietary intake, depleted pre-pregnancy iron stores, repeated pregnancies, and delayed detection.[5] These findings show that prevalence estimates differ across locations and periods, but the public-health importance remains substantial.

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Maternal anaemia is clinically relevant beyond a low laboratory value. Meta-analytic evidence links antenatal anaemia with low birth weight, preterm birth, perinatal mortality, and neonatal mortality.[6] Updated evidence also associates low maternal haemoglobin with stillbirth, postpartum haemorrhage, blood transfusion, pre-eclampsia, and other adverse outcomes, with larger risks at lower haemoglobin concentrations.[7] Severe anaemia has a particularly important relationship with maternal mortality during pregnancy and the postpartum period.[8] Early identification is therefore essential for preventing progression and for initiating dietary correction, supplementation, investigation of underlying causes, and appropriate referral.

The determinants of anaemia vary between communities and health facilities. Indian hospital-based studies have reported associations with gestational age, socioeconomic disadvantage, gravidity, timing of antenatal registration, and selected nutritional or psychological factors.[9,10] Prenatal iron use improves maternal haemoglobin and reduces anaemia and low-birth-weight risk,[11] yet adherence is frequently suboptimal because of gastrointestinal adverse effects, inadequate counselling, forgetfulness, interrupted supplies, and late initiation.[12,13] Evidence from Southern India further demonstrates that anaemia and iron deficiency can be present early in pregnancy and are associated with adverse perinatal outcomes.[14] Local data are therefore necessary to identify women who require additional attention within routine antenatal services.

The present study was undertaken to determine the prevalence and severity of anaemia among pregnant women attending antenatal care at Government Medical College, Ramagundam, Telangana, India. The secondary objective was to evaluate sociodemographic, obstetric, nutritional, dietary, and iron-folic acid supplementation factors associated with anaemia and to identify independent predictors after adjustment for potential confounding variables.

Materials and Methods

Study design and setting: This hospital-based cross-sectional study was conducted in the antenatal clinic of the Department of Obstetrics and Gynaecology, Government Medical College, Ramagundam, Telangana, India, from November 2024 to October 2025. Reporting followed the principles of the Strengthening the Reporting of Observational Studies in Epidemiology statement.

Study population and eligibility: Pregnant women aged 18 years or older, in any trimester, with a confirmed pregnancy and an available haemoglobin assessment were eligible. Women with active obstetric bleeding, blood transfusion within the preceding three months, known haemoglobinopathy, haematological malignancy, severe chronic renal or hepatic disease, or incomplete essential records were excluded. Consecutive eligible attendees were enrolled after written informed consent until the required sample was reached.

Sample size: The sample size for a single population proportion was calculated as $n = Z^2p(1-p)/d^2$. A prevalence of 52.2% from a national analysis of pregnant women in India,3 a 95% confidence level, and 10% absolute precision produced a minimum of 96 participants. The target was rounded to 100.

Data collection and definitions: Data were obtained through participant interviews, antenatal records, and clinical assessment using a predesigned schedule. Variables included age, residence, education, socioeconomic status, gravidity, trimester, birth interval, anthropometry, dietary diversity, tea or coffee consumption near meals, and iron-folic acid use. Socioeconomic status was grouped as lower versus middle or higher. Body mass index was calculated from measured weight and height; values below 18.5 kg/m² indicated underweight. Low dietary diversity was defined as consumption of fewer than five of ten food groups during the preceding 24 hours. Regular tea or coffee intake within one hour before or after meals was recorded. Consumption of less than 80% of prescribed iron-folic acid tablets during the preceding month was classified as poor adherence.12,13 A birth interval below two years was considered short; participants without a previous birth were retained in the reference category for the reported binary analysis.

Haemoglobin assessment: Venous blood was analysed using a calibrated automated haematology analyser in the institutional laboratory with routine internal quality control. Anaemia was defined as haemoglobin below 11.0 g/dL and classified as mild at 10.0–10.9 g/dL, moderate at 7.0–9.9 g/dL, and severe below 7.0 g/dL.

Statistical analysis: Data were analysed using IBM SPSS Statistics for Windows, version 26.0. Continuous variables were summarised as mean and standard deviation; categorical variables were expressed as frequencies and percentages. Prevalence was reported with a 95% confidence interval. Associations were assessed using Pearson's chi-square test, crude odds ratios, and 95% confidence intervals. Variables with $p<0.20$ in unadjusted analysis and clinically relevant factors were considered for multivariable binary logistic regression. Adjusted odds ratios with 95% confidence intervals were reported; $p<0.05$ denoted statistical significance.

Ethical considerations: Necessary Permissions were obtained before starting the study. Confidentiality was protected, and participants with anaemia received counselling and treatment according to institutional protocols.

Results

Participant recruitment

During the study period, 106 pregnant women attending the antenatal care clinic were assessed for eligibility. Six women were excluded: three did not meet the eligibility criteria, two declined participation, and one had an incomplete haemoglobin report. The remaining 100 participants were included in the final analysis. Complete sociodemographic, obstetric, nutritional, iron-folic acid supplementation, and haemoglobin data were available for all participants.

Sociodemographic and obstetric characteristics

The mean age of the participants was 25.9 ± 4.4 years, with a range of 18-38 years. Forty-two women (42.0%) were aged 18-24 years, 37 (37.0%) were aged 25-29 years, and 21 (21.0%) were aged 30 years or older. Fifty-nine participants (59.0%) resided in rural areas. Thirty-nine women (39.0%) had education below the secondary level, and 41 (41.0%) belonged to the lower socioeconomic category. Multigravidae constituted 64.0% of the sample. Half of the women were in the third trimester, while 36.0% and 14.0% were in the second and first trimesters, respectively. Underweight status was present in 21.0%. Poor iron-folic acid adherence was reported by 42.0%, low dietary diversity by 35.0%, and tea or coffee intake near meals by 42.0% (Table 1).

Table 1. Baseline characteristics of the study participants

Characteristic	Number (%)
Age, years, mean ± SD	25.9 ± 4.4
Age 18-24 years	42 (42.0)
Age 25-29 years	37 (37.0)
Age ≥30 years	21 (21.0)
Rural residence	59 (59.0)
Education below secondary level	39 (39.0)
Lower socioeconomic status	41 (41.0)
Primigravida	36 (36.0)
Multigravida	64 (64.0)
First trimester	14 (14.0)

Second trimester	36 (36.0)
Third trimester	50 (50.0)
Underweight	21 (21.0)
Birth interval <2 years	29 (29.0)
Poor iron-folic acid adherence	42 (42.0)
Low dietary diversity	35 (35.0)
Tea/coffee consumption near meals	42 (42.0)

Prevalence and severity of anaemia

The mean haemoglobin concentration was 10.4 ± 1.4 g/dL. Anaemia was identified in 56 of the 100 women, corresponding to a prevalence of 56.0% (95% confidence interval [CI] 46.2%-65.3%). In the total sample, 31 women had mild anaemia, 21 had moderate anaemia, and four had severe anaemia. Among anaemic participants, mild, moderate, and severe anaemia accounted for 55.4%, 37.5%, and 7.1%, respectively (Table 2).

Table 2. Prevalence and severity of anaemia

Anaemia status	Number (%)	Percentage among anaemic women
No anaemia	44 (44.0)	–
Mild anaemia	31 (31.0)	55.4
Moderate anaemia	21 (21.0)	37.5
Severe anaemia	4 (4.0)	7.1
Any anaemia	56 (56.0)	100.0

Anaemia according to trimester

Anaemia prevalence increased across gestational trimesters. It was present in 4 of 14 women in the first trimester (28.6%), 18 of 36 in the second trimester (50.0%), and 34 of 50 in the third trimester (68.0%). The overall difference across the three trimesters was statistically significant (p=0.021). When the first and second trimesters were combined as the reference group, women in the third trimester had 2.70-fold higher odds of anaemia (95% CI 1.20-6.11; p=0.016).

Factors associated with anaemia

In unadjusted analysis, anaemia was more frequent among rural than urban residents (66.1% versus 41.5%; p=0.015) and among women in the lower socioeconomic category than those in the middle or higher categories (70.7% versus 45.8%; p=0.013). Underweight women had a prevalence of 76.2%, compared with 50.6% among women who were not underweight (p=0.036). Poor iron-folic acid adherence showed the largest crude association: 73.8% of women with poor adherence were anaemic, compared with 43.1% of women with satisfactory adherence (odds ratio [OR] 3.72; 95% CI 1.57-8.81; p=0.002). Low dietary diversity was also associated with anaemia (71.4% versus 47.7%; p=0.023). Short birth interval and tea or coffee intake near meals showed increased odds without statistical significance. Gravidity was not significantly associated with anaemia (Table 3).

Table 3. Unadjusted associations between selected factors and anaemia

Risk factor	Anaemic, n/N (%)	Non-anaemic, n/N (%)	Unadjusted OR (95% CI)	p-value
Rural residence	39/59 (66.1)	20/59 (33.9)	2.75 (1.21-6.27)	0.015
Lower socioeconomic status	29/41 (70.7)	12/41 (29.3)	2.86 (1.23-6.67)	0.013
Multigravidity	39/64 (60.9)	25/64 (39.1)	1.74 (0.76-3.98)	0.15
Third trimester	34/50 (68.0)	16/50 (32.0)	2.70 (1.20-6.11)	0.016
Underweight	16/21 (76.2)	5/21 (23.8)	3.12 (1.04-9.34)	0.036
Birth interval <2 years	20/29 (69.0)	9/29 (31.0)	2.16 (0.87-5.39)	0.095
Poor iron-folic acid adherence	31/42 (73.8)	11/42 (26.2)	3.72 (1.57-8.81)	0.002
Low dietary diversity	25/35 (71.4)	10/35 (28.6)	2.74 (1.14-6.61)	0.023
Tea/coffee consumption near meals	28/42 (66.7)	14/42 (33.3)	2.14 (0.94-4.88)	0.067

Variables meeting the prespecified screening criterion were evaluated in the multivariable model. Lower socioeconomic status, third-trimester pregnancy, underweight status, and poor iron-folic acid adherence remained independently associated with anaemia. Poor adherence was associated with more than threefold higher adjusted odds (adjusted OR [aOR] 3.41; 95% CI 1.38-8.43; p=0.008). Underweight women had an aOR of 2.91 (95% CI 1.01-8.38; p=0.048), while third-trimester participants had an aOR of 2.63 (95% CI 1.08-6.39; p=0.033). Lower socioeconomic status was associated with an aOR of 2.47 (95% CI 1.03-5.93; p=0.043). Rural residence and low dietary diversity retained elevated adjusted odds but did not reach statistical significance (Table 4).

Table 4. Multivariable logistic regression analysis of factors associated with anaemia

Variable	Adjusted OR	95% CI	p-value
Rural residence	2.19	0.92-5.21	0.076
Lower socioeconomic status	2.47	1.03-5.93	0.043
Third trimester	2.63	1.08-6.39	0.033
Underweight	2.91	1.01-8.38	0.048
Poor iron-folic acid adherence	3.41	1.38-8.43	0.008
Low dietary diversity	2.36	0.96-5.79	0.061

Summary of principal findings

Overall, more than half of the study population had anaemia. Mild anaemia was the largest severity category, although 44.6% of anaemic participants had moderate or severe disease. The adjusted findings identified socioeconomic disadvantage, advanced gestation, underweight nutritional status, and poor iron-folic acid adherence as the principal independent correlates.

Discussion

The present study found anaemia in 56.0% of pregnant women attending antenatal care, confirming a substantial burden in this hospital population. This estimate is close to the 52.2% prevalence reported in the 2019-2021 National Family Health Survey analysis.3 It exceeds the 33.9% reported from a public-sector hospital in Bengaluru,9 but is lower than the 84.9% recorded in the earlier 16-district Indian survey4 and the 90% reported from a rural medical college in West Bengal.10 Differences in sampling frames, gestational distribution, referral patterns, socioeconomic composition, laboratory methods, and antenatal supplementation coverage probably account for much of this variation. The comparison also shows that local prevalence cannot be inferred reliably from national or distant regional estimates.

Mild anaemia was the commonest category, but moderate and severe anaemia together represented 44.6% of anaemic women. This distribution is clinically important because the consequences of low haemoglobin become greater as severity increases. Meta-analyses have linked maternal anaemia with preterm birth, low birth weight, perinatal mortality, and neonatal mortality,6 while updated evidence has identified associations with postpartum haemorrhage, transfusion, stillbirth, and pre-eclampsia.7 Severe anaemia has also been associated with an increased risk of maternal death.8 These observations support prompt treatment of mild disease and intensified evaluation of women with moderate or severe anaemia.

Anaemia prevalence rose progressively from the first to the third trimester, and third-trimester pregnancy remained independently associated after adjustment. Haemodilution, expansion of maternal red-cell mass, fetal iron transfer, and increasing nutritional requirements offer plausible explanations. The Bengaluru study similarly observed declining mean haemoglobin as gestation advanced,9 whereas a Southern Indian cohort demonstrated that anaemia and iron deficiency were already common at the first prenatal assessment.14 Together, these findings indicate that screening early in pregnancy and repeat assessment later are both necessary.

Lower socioeconomic status and underweight were independent correlates. Socioeconomic disadvantage influences food quality, sanitation, healthcare access, treatment continuity, and the ability to manage supplement-related adverse effects. The national Indian analysis reported higher anaemia among women from the poorest households,3 and the West Bengal study identified socioeconomic status as an important factor.10 Underweight status probably represents depleted pre-pregnancy nutrient reserves and sustained dietary inadequacy. Low dietary diversity showed an association in unadjusted analysis, reinforcing the need to address diet quality rather than relying solely on tablet distribution.

Poor iron-folic acid adherence was the strongest modifiable factor. Prenatal iron use reduces maternal anaemia and improves selected birth outcomes,11 but systematic evidence shows that adherence remains limited across settings.12 Reported barriers include gastrointestinal symptoms, forgetfulness, inadequate counselling, interrupted supply, and late antenatal initiation.13 Routine care should therefore combine uninterrupted provision with practical counselling on dosing, side-effect management, dietary iron sources, vitamin C intake, and separation of tea or coffee from meals. Focused follow-up for underweight women, late-gestation attendees, and socioeconomically vulnerable families could improve risk-based antenatal care.

LIMITATIONS

The single-centre cross-sectional design limits generalisability and does not establish the temporal direction of observed associations. Dietary diversity, beverage timing, and supplement adherence relied partly on self-report and were susceptible to recall and social-desirability bias. Ferritin, vitamin B12, folate, inflammatory markers, stool testing, and haemoglobinopathy screening were not performed. The modest sample size produced wide confidence intervals for several predictors, and haemoglobin was assessed at one study visit.

Conclusion

Anaemia was present in 56.0% of pregnant women attending antenatal care, confirming a high burden. Mild anaemia was most frequent, but a substantial proportion had moderate or severe disease. Lower socioeconomic status, third-trimester pregnancy, underweight nutritional status, and poor adherence to iron-folic acid supplementation were independent correlates. Antenatal services should strengthen haemoglobin screening at registration and later gestation, assess nutritional vulnerability, ensure uninterrupted supplement availability, and provide counselling on adherence, adverse-effect management, dietary diversity, and meal-related beverage practices. Risk-based follow-up of underweight and socioeconomically disadvantaged women is essential. Larger multicentre studies incorporating iron, folate, vitamin B12, inflammatory, infectious, and haemoglobinopathy assessments would clarify underlying causes and guide targeted interventions.

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