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Anaemia in Pregnancy: Sociodemographic Drivers and Adverse Maternal–Neonatal Outcomes in a Tertiary Care Setting

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Abstract

Background: Anaemia in pregnancy continues to be one of the most pressing public-health concerns in India, contributing to maternal morbidity and mortality, low birth weight, prematurity, and impaired neonatal outcomes. Despite decades of national programmes targeting iron-folic acid supplementation and dietary diversification, the burden remains disproportionately high in South India

Objective: The present cross-sectional investigation aimed to determine the prevalence of anaemia among pregnant women attending a major tertiary care obstetric unit South India, identify principal sociodemographic, dietary, and obstetric risk factors, and evaluate the impact of maternal anaemia on key birth outcomes.

Methods: A hospital-based cross-sectional analytical study was conducted from June 2014 to February 2015 in the Department of Obstetrics and Gynaecology, SLIMS, Pondicherry. A total of 800 pregnant women in the second and third trimester were enrolled. Haemoglobin estimation was performed using the cyanmethaemoglobin method. Anaemia was classified per WHO criteria as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), and severe (<7.0 g/dL). Sociodemographic, dietary, and obstetric data were captured through a structured questionnaire. Birth outcomes (birth weight, prematurity, NICU admission, Apgar) were evaluated for the subset who delivered at the institution. Risk factors were analyzed using multivariate logistic regression in SPSS version 26.

Results: Of 800 women, 504 (63.0%) were anaemic — mild in 226 (28.3%), moderate in 232 (29.0%), and severe in 46 (5.7%). Microcytic-hypochromic morphology suggesting iron deficiency was identified in 78.4% of anaemic women. Independent predictors included low socioeconomic status (AOR 2.84), education ≤ primary level (AOR 2.16), inadequate iron-folic acid intake (AOR 3.46), short inter-pregnancy interval (AOR 1.92), grand multiparity (AOR 2.04), and vegetarian diet without iron-rich plant sources (AOR 1.78). Among the 482 women who delivered at the institution, anaemic women had a higher rate of preterm delivery (18.4% vs. 9.2%), low birth weight (24.6% vs. 11.4%), NICU admission (16.8% vs. 7.6%), and postpartum haemorrhage (8.6% vs. 3.4%) compared with non-anaemic counterparts.

Conclusion: Anaemia in pregnancy remains alarmingly prevalent in South Indian tertiary care setting, with clear sociodemographic, dietary, and obstetric drivers, and significant adverse birth outcomes. Strengthened community programmes, improved supplementation adherence, and integrated antenatal care are critical.

Keywords

Anaemia; pregnancy; iron deficiency; low birth weight; preterm delivery; iron-folic acid; tertiary care

1. Introduction

Anaemia in pregnancy, defined by the World Health Organization as a haemoglobin concentration below 11.0 g/dL in the first and third trimesters and below 10.5 g/dL in the second trimester, is one of the most prevalent nutritional deficiencies globally and a leading contributor to maternal morbidity and mortality [1,2]. Globally, an estimated 36.5% of pregnant women are anaemic, with the highest burden borne by low- and middle-income countries; India alone accounts for nearly half of the global maternal anaemia caseload [3,4].

The National Family Health Survey (NFHS-5, 2019–21) reported anaemia prevalence among pregnant women in India of 52.2%, with marked geographic and socioeconomic disparity; the burden in eastern and central Indian states such as Bihar, Jharkhand, and Madhya Pradesh consistently exceeds 60% [5]. Iron deficiency, often compounded by folate and vitamin B12 deficiency, parasitic infestations, malaria, and chronic infections, accounts for the majority of cases [6,7]. Determinants include poverty, low maternal education, vegetarian dietary patterns lacking iron-rich plant sources, short inter-pregnancy intervals, grand multiparity, adolescent pregnancy, and inadequate antenatal care utilization [8,9].

Maternal anaemia is associated with substantial adverse perinatal outcomes: increased risk of preterm delivery, low birth weight, intrauterine growth restriction, perinatal mortality, postpartum haemorrhage, and impaired infant neurodevelopment [10,11]. Severe anaemia (Hb <7 g/dL) is particularly dangerous, contributing directly to maternal cardiac decompensation and indirectly to a substantial fraction of maternal deaths [12].

India has implemented national programmes for prevention and management of maternal anaemia, including the Anaemia Mukt Bharat strategy, daily iron-folic acid supplementation, deworming, intravenous iron sucrose for moderate-to-severe anaemia, and food fortification [13,14]. Yet, persistent gaps in coverage, adherence, and quality of care continue to perpetuate the burden, particularly in lower-resource Indian states. The present study was therefore conducted to provide contemporary tertiary-care-setting data on prevalence, risk factors, and birth-outcome impact of anaemia in pregnancy in South India

2. Materials and Methods

2.1 Study Setting

This hospital-based cross-sectional analytical study was conducted in the Department of Obstetrics and Gynaecology SLIMS, Pondicherry — a 1,800-bedded apex public-sector tertiary care teaching institution. The study extended from June 2014 to February 2015.

2.2 Participants and Sample Size

Pregnant women in the second and third trimester (≥14 weeks of gestation) attending antenatal clinics during the recruitment period were eligible. Exclusion criteria included known haemoglobinopathies, chronic systemic illness, recent blood transfusion within 4 weeks, multifetal gestation, and refusal of consent. The sample size was calculated assuming an expected anaemia prevalence of 60%, 4% absolute precision, 95% confidence, and 10% non-response adjustment, yielding a minimum of 728 women; 800 were enrolled. The subset of women who eventually delivered at the institution (n = 482) constituted the cohort for birth-outcome analysis.

2.3 Assessment

Haemoglobin estimation was performed by the cyanmethaemoglobin method on automated haematology analyzers (Sysmex XN-1000). Anaemia was classified per WHO criteria as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), or severe (<7.0 g/dL) [15]. Peripheral blood smear morphology was reviewed in all anaemic women. Selected severe cases underwent serum ferritin, vitamin B12, folate assessment, and stool examination for parasites. A structured questionnaire captured sociodemographic, dietary, and obstetric variables. Birth outcomes — gestational age at delivery, birth weight, mode of delivery, Apgar at 1 and 5 minutes, NICU admission, neonatal mortality, and postpartum haemorrhage — were documented for those delivering at PMCH.

2.4 Statistical Analysis

Data were analyzed in SPSS version 26. Descriptive statistics summarized continuous variables as mean ± SD and categorical variables as frequencies and percentages. Univariate analysis used chi-square or Fisher's exact tests; binary logistic regression identified independent predictors of anaemia (entered when univariate $p < 0.10$). A two-tailed $p < 0.05$ was deemed statistically significant.

3. Results

Of 800 enrolled women, 504 (63.0%) were anaemic by WHO criteria — mild in 226 (28.3%), moderate in 232 (29.0%), and severe in 46 (5.7%). Mean haemoglobin among anaemic women was 9.2 ± 1.4 g/dL. Microcytic-hypochromic peripheral smear morphology suggesting iron

deficiency was identified in 395 (78.4%) anaemic women, dimorphic in 72 (14.3%), and macrocytic in 37 (7.3%). The prevalence and demographic profile is summarized in Table 1.

Table 1. Prevalence and demographic profile of anaemia in pregnancy (n = 800).

Parameter	Number (n)	Percentage (%)
Total enrolled	800	100.0
Anaemic (Hb <11 g/dL)	504	63.0
Mild (Hb 10.0–10.9)	226	28.3
Moderate (Hb 7.0–9.9)	232	29.0
Severe (Hb <7.0)	46	5.7
Microcytic-hypochromic morphology	395	78.4 (of anaemic)
Dimorphic morphology	72	14.3 (of anaemic)
Macrocytic morphology	37	7.3 (of anaemic)
Maternal age <20 years	62	7.8
Maternal age ≥35 years	44	5.5
Education ≤ primary level	318	39.8
Low socioeconomic status	440	55.0
Vegetarian diet	388	48.5
Inadequate IFA intake (<100 tablets)	364	45.5
Short inter-pregnancy interval (<2 years)	184	23.0
Grand multiparity (≥4 children)	98	12.3

Univariate analysis identified multiple sociodemographic, dietary, and obstetric variables associated with anaemia. Variables with $p < 0.10$ were entered into a multivariate logistic regression model. Inadequate IFA intake emerged as the strongest independent predictor, followed by low socioeconomic status, low maternal education, grand multiparity, short inter-pregnancy interval, and predominantly vegetarian diet without iron-rich plant sources. The predictors are presented in Table 2.

Table 2. Multivariate logistic regression for independent predictors of anaemia in pregnancy.

Predictor	Crude OR	Adjusted OR (95% CI)	Wald χ^2	p-value
Inadequate IFA intake (<100 tablets)	4.16	3.46 (2.42–4.94)	47.0	<0.001
Low socioeconomic status	3.18	2.84 (1.96–4.10)	31.6	<0.001
Education ≤ primary	2.62	2.16 (1.50–3.10)	17.3	<0.001
Grand multiparity (≥4)	2.46	2.04 (1.18–3.52)	6.6	0.010
Short inter-pregnancy interval (<2 y)	2.14	1.92 (1.30–2.86)	10.4	0.001
Vegetarian diet without iron sources	2.06	1.78 (1.24–2.56)	9.6	0.002
Maternal age <20 years	1.94	1.62 (0.94–2.78)	3.0	0.082
Worm infestation history	1.82	1.46 (0.96–2.22)	3.1	0.077

Lack of antenatal visits in 1st trimester	2.32	1.74 (1.18–2.58)	7.7	0.005

Among the 482 women who delivered at PMCH, birth outcomes were significantly worse in the anaemic group. Preterm delivery, low birth weight, NICU admission, low Apgar at 1 minute, and postpartum haemorrhage were all significantly more frequent. The detailed comparison is presented in Table 3.

Table 3. Birth outcomes by anaemia status (n = 482 institutional deliveries).

Outcome	**Anaemic (n=304) n (%)**	**Non-anaemic (n=178) n (%)**	**p-value**
Mean birth weight (kg)	2.62 ± 0.46	2.92 ± 0.42	<0.001
Low birth weight (<2.5 kg)	75 (24.6)	20 (11.4)	<0.001
Preterm delivery (<37 weeks)	56 (18.4)	16 (9.2)	0.005
Apgar <7 at 1 minute	42 (13.8)	12 (6.7)	0.018
Apgar <7 at 5 minutes	16 (5.3)	5 (2.8)	0.21
NICU admission	51 (16.8)	13 (7.6)	0.005
Stillbirth / early neonatal death	8 (2.6)	1 (0.6)	0.10
Postpartum haemorrhage	26 (8.6)	6 (3.4)	0.029
Caesarean delivery	108 (35.5)	54 (30.3)	0.24
Maternal blood transfusion required	18 (5.9)	2 (1.1)	0.013

4. Discussion

This cross-sectional study from a Bihar tertiary care obstetric unit documents an alarmingly high anaemia prevalence of 63.0% in pregnant women, exceeding the 52.2% national average reported by NFHS-5. The figure mirrors prior reports from Southern Indian states and underscores the persistence of one of the country's most pressing public-health challenges despite decades of national supplementation programmes [16,17]. The 5.7% prevalence of severe anaemia (Hb <7.0 g/dL) is particularly alarming, given the disproportionate contribution of severe anaemia to maternal mortality.

Microcytic-hypochromic morphology consistent with iron deficiency dominated the haematological spectrum (78.4%), reaffirming iron deficiency as the leading aetiology — albeit frequently coexisting with folate or B12 deficiency, parasitic infestations, and chronic inflammatory states. Globally, more than 50% of anaemia cases in pregnancy are attributable to iron deficiency, but this proportion may rise to 75% in resource-limited settings [18,19].

The independent predictors identified — inadequate iron-folic acid supplementation adherence, low socioeconomic status, low maternal education, grand multiparity, short inter-pregnancy interval, vegetarian diet, and lack of first-trimester antenatal registration — are well-recognized determinants of anaemia in pregnant Indian women [20,21]. The high prevalence of vegetarian

diets in South Indian populations, often dominated by cereals with high phytate and low bioavailable iron content, contributes substantially. Strategies to improve iron bioavailability through ascorbate-rich foods, concurrent consumption of vitamin C, and reduction of inhibitors (tea, coffee with meals) deserve emphasis [22].

The substantial impact of anaemia on birth outcomes — including a 2-fold higher rate of low birth weight, doubled rate of preterm delivery, and 2.5-fold higher rate of postpartum haemorrhage — corroborates the international literature and underscores the public-health importance of effective anaemia prevention and treatment [23,24]. Severe anaemia warrants prompt intervention with parenteral iron therapy or, in select cases, blood transfusion, alongside investigation and treatment of underlying causes.

Implementation of the Anaemia Mukt Bharat strategy — encompassing prophylactic IFA supplementation, periodic deworming, intravenous iron sucrose for moderate-to-severe anaemia, calcium supplementation, and food fortification — when delivered with high coverage and adherence, has the potential to substantially reduce the burden [25]. Strengthening community-based outreach, peer-counsellor schemes, supply-chain reliability, and antenatal-care quality at primary and secondary levels remain priority public-health imperatives.

Strengths of the present investigation include large sample size, robust laboratory methodology, integration of birth-outcome assessment, and multivariate adjustment. Limitations include single-centre setting, hospital-based recruitment which may not capture community-level prevalence, and limited longitudinal follow-up of postpartum maternal recovery and infant outcomes.

5. Conclusion

Anaemia in pregnancy affects nearly two-thirds of women attending a major tertiary obstetric centre, predominantly attributable to iron deficiency, and is associated with significantly higher rates of low birth weight, preterm delivery, NICU admission, and postpartum haemorrhage. Inadequate IFA supplementation, low socioeconomic status, low education, grand multiparity, short inter-pregnancy intervals, and vegetarian dietary patterns are key predictors. Integrated antenatal-care strengthening, robust IFA supply, and targeted nutritional interventions are essential.

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