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Dr. Sudheera Sulgante
Associate Professor, Department of Community Medicine, Maheshwara Medical College and Hospital, Patancheru, Sangareddy, Telangana, India

Dr. Rameshwari Malshetty
Assistant Professor, Department of Obstetrics and Gynaecology, Bidar Institute of Medical Sciences, Bidar, Karnataka, India

Dr. Pushpa MB
Assistant Professor, Department of Physiology, Bidar Institute of Medical Sciences, Bidar, Karnataka, India

Dr. Mahesh Tondare
Assistant Professor, Department of Community Medicine, Bidar Institute of Medical Sciences, Bidar, Karnataka, India

Corresponding Author:
Dr. Mahesh Tondare
Assistant Professor, Department of Community Medicine, Bidar Institute of Medical Sciences, Bidar, Karnataka, India

Prevalence and determinants of anaemia among antenatal women attending a tertiary care hospital: A cross-sectional study

Sudheera Sulgante, Rameshwari Malshetty, Pushpa MB and Mahesh Tondare

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Abstract
Introduction: Anaemia in pregnancy remains a major global and national public-health problem with significant consequences for maternal and neonatal outcomes. The World Health Organization (WHO, 2024) defines anaemia in pregnancy as haemoglobin <11.0 g/dL. Despite national strategies such as Anaemia Mukt Bharat (AMB), India continues to report high prevalence, with NFHS-5 documenting ~60% anaemia among pregnant women in Bidar district, Karnataka. Understanding local prevalence and determinants is essential for targeted intervention.
Objectives: To estimate the prevalence of anaemia and to identify socio-demographic, dietary, and obstetric determinants of anaemia among antenatal women attending a tertiary care hospital in Bidar district.
Materials and Methods: A cross-sectional study was conducted among 373 pregnant women attending the antenatal clinic of a tertiary hospital in Bidar, Karnataka. Participants were selected using systematic random sampling. Data were collected using a pre-tested structured questionnaire covering socio-demographic details, dietary practices, obstetric history, and iron-folic acid (IFA) supplementation adherence. Haemoglobin estimation was performed using an automated haematology analyser and classified per WHO (2024) criteria. Statistical analysis using SPSS v26 included descriptive statistics, chi-square tests, and multivariate logistic regression. A p-value <0.05 was considered statistically significant.
Results: Anaemia prevalence was 56.9%. Mild, moderate, and severe anaemia accounted for 31.1%, 22.3%, and 3.5% respectively. Anaemia prevalence increased significantly with advancing trimester (40.9% first trimester vs 63.8% third trimester, p = 0.008). Independent determinants included low maternal education (AOR = 2.38; p = 0.002), multiparity ≥3 (AOR = 1.84; p = 0.01), short inter-pregnancy interval <2 years (AOR = 1.68; p = 0.04), and poor IFA adherence (<80 tablets; AOR = 2.59; *p*<0.001).
Conclusion: Strengthening early antenatal care, promoting supplementation adherence, improving dietary counselling, and integrating reproductive health education are critical for reducing maternal anaemia in high-burden districts.

Keywords: Anaemia, pregnancy, prevalence, iron-folic acid, NFHS-5

Introduction

Anaemia during pregnancy remains one of the most widespread nutritional disorders globally and a major contributor to maternal and perinatal morbidity and mortality. The World Health Organization (WHO, 2024) defines anaemia in pregnancy as a haemoglobin concentration of less than 11.0 g/dL, and classifies it as mild (10.0-10.9 g/dL), moderate (7.0-9.9 g/dL), and severe (<7.0 g/dL) [1]. Globally, anaemia affects approximately 40% of pregnant women, with the highest prevalence observed in low- and middle-income countries, especially in South Asia and sub-Saharan Africa [2].

Anaemia in pregnancy is multifactorial in origin — the most common cause being iron deficiency, but other etiologies such as folate and vitamin B12 deficiency, malaria, parasitic infestations, and haemoglobinopathies also contribute [3, 4]. During pregnancy, increased plasma volume, fetal iron demands, and dietary insufficiency together create a negative iron balance, predisposing women to anaemia.

In India, the burden of maternal anaemia remains alarmingly high despite the implementation of national initiatives such as the National Iron Plus Initiative (NIPI) and the Anaemia Mukt Bharat (AMB) strategy.

According to the National Family Health Survey (NFHS-5, 2019-21), the national prevalence of anaemia among pregnant women is 52.2%, and in Karnataka, it stands at approximately 45% [5]. However, in Bidar district, the prevalence is substantially higher, reported at around 60%, indicating persistent gaps in nutritional supplementation and healthcare delivery [6].

Maternal anaemia adversely affects both maternal and neonatal outcomes, being associated with maternal fatigue, postpartum haemorrhage, pre-term birth, intrauterine growth restriction, and low birth weight [7, 8]. These consequences emphasize the dual public-health and obstetric importance of identifying and addressing anaemia early in pregnancy.

Several Indian studies have explored regional variation in prevalence and determinants. Itagi *et al*. (2022) in North Karnataka found a prevalence of 58%, identifying low education and poor iron-folic acid (IFA) compliance as significant determinants [9]. In Rajasthan, Kumar *et al*. (2019) reported 81.8% prevalence with parity and education as major risk factors [10]. In contrast, Nair *et al*. (2022) documented a lower prevalence (40%) in rural Kerala, reflecting better nutritional status and ANC coverage [11].

Regional differences such as these reflect context-specific socioeconomic, dietary, and reproductive factors, underscoring the need for district-level data to tailor interventions. Given the high prevalence of anaemia in Bidar district and its inclusion as a high-priority district under the AMB initiative, it is imperative to generate local evidence. The present study was therefore undertaken to estimate the prevalence and severity of anaemia among antenatal women attending a tertiary care hospital in Bidar, Karnataka, and to identify its socio-demographic, dietary, and obstetric determinants.

Materials and Methods

This was a hospital-based cross-sectional observational study conducted in the Department of Obstetrics and Gynaecology, Bidar Institute of Medical Sciences, Bidar, Karnataka for duration of one year. The institution is a tertiary-level referral centre catering to both rural and semi-urban populations of northern Karnataka. The district of Bidar lies in the northernmost region of Karnataka and is known for its relatively high burden of anaemia and under nutrition, making it an ideal setting for the present investigation.

Study population: All pregnant women attending the antenatal outpatient department during the study period were screened for eligibility. After applying inclusion and exclusion criteria, those who consented to participate were enrolled.

Inclusion criteria

- Pregnant women (any trimester) attending ANC-OPD.
- Willing to provide written informed consent.

Exclusion criteria

- Women with known haemoglobinopathies (thalassemia, sickle cell disease).
- Chronic systemic illnesses (renal, hepatic, or cardiac disorders).
- Women who received blood transfusion within 3 months before enrolment.

Sample size

The sample size was calculated using the formula $n = 4pq/d^2$, where p = 58% (prevalence of anaemia among antenatal women in North Karnataka as per Itagi *et al*., 2022) [14], q = 100 - p = 42, and d = 10% relative precision. The minimum required sample size was 373, which was achieved using systematic random sampling.

Data collection procedure

A pre-tested, structured questionnaire in English and Kannada was administered by trained investigators. The tool comprised four parts:

Socio-demographic information: Age, education, occupation, family income, and type of residence.

Obstetric history: Gravida, parity, trimester, and inter-pregnancy interval.

Dietary habits: Type of diet (vegetarian/mixed), frequency of consumption of green leafy vegetables, pulses, and iron-rich foods; frequency of tea/coffee intake.

IFA supplementation: Number of tablets consumed (<80 or ≥80), reasons for non-adherence, and counselling received.

Haemoglobin Estimation and Classification

Venous blood (2 mL) was collected under aseptic precautions and analysed using an automated haematology analyser (Sysmex XN-1000). Quality control procedures were followed daily. Anaemia was classified as per WHO 2024 guidelines [1]: Mild: 10.0-10.9 g/dL, Moderate: 7.0-9.9 g/dL, Severe: < 7.0 g/dL.

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants after explaining study objectives, confidentiality, and voluntary participation.

Statistical Analysis

Data were entered in Microsoft Excel and analysed using SPSS version 26.0. Descriptive statistics (frequency, mean, SD, and percentage) summarized participant characteristics. Chi-square test assessed associations between categorical variables. Multivariate logistic regression identified independent predictors of anaemia; results expressed as Adjusted Odds Ratios (AOR) with 95% Confidence Intervals (CI). Statistical significance was set at $p<0.05$.

Result

Table 1: Socio-demographic characteristics of antenatal women

Characteristic	Frequency	Percentage
Age (years)		
< 20	42	11.3
21-25	164	44.0
26-30	105	28.2
> 30	62	16.6
Education		
Illiterate/Primary	98	26.3
Secondary	82	22.0
Higher secondary	119	31.9
Graduate and above	74	19.8
Occupation		
Homemaker	295	79.1
Employed	78	20.9
Socio-economic class		
Upper-middle	34	9.1
Lower-middle	223	59.8
Lower	116	31.1
Residence		
Urban	228	61.1
Rural	145	38.9

Table 1 shows that most participants (44%) were aged 21-25 years, followed by 26-30 years (28.2%). Nearly one-fourth (26.3%) of women had only primary-level education, and 22% had completed secondary education, indicating that almost half of the respondents had education limited to secondary school or below. The majority were homemakers (79.1%) and belonged to the lower-middle socioeconomic class (59.8%). About 61% resided in urban areas, while 39% were from rural settings. These findings suggest that the study population largely comprised young, low- to middle-income women with modest educational attainment, typical of antenatal attendees in public tertiary hospitals.

Table 2: Obstetric and dietary characteristics of study participants

Variable	Frequency	Percentage
Gravida		
Primigravida	127	34.0
Multigravida (2-3)	166	44.5
Grand multipara (≥ 4)	80	21.5
Trimester		
First	93	24.9
Second	130	34.9
Third	150	40.2
Inter-pregnancy interval (months)		
< 24	134	35.9
≥ 24	239	64.1
Dietary pattern		
Vegetarian	186	49.9
Mixed	187	50.1
Iron-folic acid intake		
< 80 tablets	202	54.1
≥ 80 tablets	171	45.9

As presented in Table 2, most participants were multigravida (44.5%), followed by primigravida women (34%). One-fifth (21.5%) were grand multipara (≥4 pregnancies). Regarding gestational age, 40.2% were in the third trimester, 34.9% in the second, and 24.9% in the first trimester. More than one-third (35.9%) had a short inter-pregnancy interval of less than 24 months. Half of the women (49.9%) followed a vegetarian diet, and more than half (54.1%) had consumed fewer than 80 IFA tablets.

Table 3: Prevalence and severity of anaemia among antenatal women

Haemoglobin status	Haemoglobin (g/dL)	Number	%
Normal	≥ 11.0	161	43.1
Anaemic (total)	< 11.0	212	56.9
Mild	10.0-10.9	116	31.1
Moderate	7.0-9.9	83	22.3
Severe	< 7.0	13	3.5
Mean ± SD Hb	—	10.14 ± 1.32 g/dL	—

Table 3 demonstrates that the overall prevalence of anaemia among the study participants was 56.9%. Mild anaemia (10-10.9 g/dL) was most common (31.1%), followed by moderate anaemia (22.3%) and severe anaemia (3.5%). The mean haemoglobin level was 10.14 ± 1.32 g/dL. These findings indicate that more than half of the antenatal women were anaemic, predominantly with mild-to-moderate severity.

Table 4: Association between anaemia and trimester of pregnancy

Trimester	Total	Anaemic	Anaemic (%)	χ^2	p-value
First	93	38	40.9		
Second	130	74	56.9		
Third	150	96	63.8	9.69	0.008
Total	373	212	56.9		

Table 4 highlights that anaemia prevalence increased progressively with gestational age, from 40.9% in the first trimester to 56.9% in the second and 63.8% in the third. The association between trimester and anaemia was statistically significant (χ^2 = 9.69, p =.008). This pattern aligns with physiological haemodilution and the increased iron demands of advancing pregnancy, emphasizing the need for early screening and supplementation during the first trimester.

Table 5: Determinants of anaemia among antenatal women

Determinant	Category	Adjusted OR (95% CI)	p-value
Education	≤ Secondary vs ≥ Higher secondary	2.38 (1.34 - 4.00)	0.002
Parity	≥ 3 vs < 3	1.84 (1.09 - 3.10)	0.01
Inter-pregnancy interval	< 24 months vs ≥ 24 months	1.68 (1.01 - 2.94)	0.04
IFA adherence	< 80 tabs vs ≥ 80 tabs	2.59 (1.54 - 4.35)	< 0.001
Dietary pattern	Vegetarian vs Mixed	1.33 (0.86 - 2.07)	0.12
Socio-economic class	Lower vs Upper-middle	1.27 (0.79 - 2.04)	0.20

Table 5 summarizes the multivariate logistic regression analysis identifying significant predictors of anaemia. Women with education up to secondary school were over twice as likely to be anaemic compared to those with higher education (AOR = 2.38, 95% CI [1.34, 4.00], p =.002). Multiparity (≥3) also showed a significant association (AOR = 1.84, p =.01), as did a short inter-pregnancy interval (<24 months; AOR = 1.68, p =.04). Poor adherence to IFA supplementation (<80 tablets) was the strongest determinant (AOR = 2.59, p<.001). Dietary pattern and socioeconomic class did not show significant associations.

Discussion

The present study revealed that 56.9% of antenatal women were anaemic, confirming that anaemia remains a moderate to severe public-health issue in Bidar district. The magnitude closely matches NFHS-5 estimates (60%) [3] and corroborates data from other studies in North Karnataka (58%) [14] and Belagavi (72.7%) [4].

Prevalence and severity

The observed prevalence indicates persistent nutritional and programmatic gaps despite the implementation of Anaemia Mukt Bharat and the National Iron Plus Initiative. Mild and moderate anaemia constituted over half of cases, which mirrors findings from other Indian studies [9, 10, 12]. This predominance of mild forms may reflect partial success of ongoing iron supplementation programmes but also continued dietary insufficiency and poor adherence.

The mean haemoglobin level of 10.1±1.3 g/dL, only slightly above the anaemia threshold, signifies that even “non-anaemic” women have marginal iron reserves, rendering them vulnerable to developing anaemia later in pregnancy. The trimester-wise

increase in prevalence—from 40.9% in the first trimester to 63.8% in the third—is attributable to physiological haemodilution, expansion of plasma volume, and uncorrected iron deficits as gestation advances [1, 10]. These findings underscore the critical need for early antenatal registration and first-trimester supplementation.

Socio-demographic determinants

Educational attainment emerged as a key determinant: women with ≤ secondary education had more than twice the risk of anaemia (AOR = 2.38, p = 0.002). Education likely improves health literacy, awareness about nutrition, and compliance with supplementation [11, 14]. Similar associations have been observed in studies from Rajasthan [15], Maharashtra [15], and Delhi [11]. In contrast, income and occupation did not remain significant after adjustment, suggesting that education plays a more direct behavioural role in mitigating risk.

Obstetric determinants

Multiparity (≥3) and short inter-pregnancy intervals (<24 months) were independently associated with anaemia (AOR = 1.84 and 1.68, respectively). Repeated pregnancies without adequate spacing deplete iron stores, a pattern documented in Kerala [16], Hyderabad [12], and Madhya Pradesh [13]. These findings reinforce the need for integrated reproductive health strategies that promote birth spacing, family planning, and postpartum supplementation.

Supplementation and dietary factors

Poor adherence to IFA supplementation (<80 tablets) was one of the strongest predictors (AOR = 2.59, p<0.001). Compliance is often hindered by side effects, lack of motivation, or irregular supply [8, 12]. Enhanced counselling during ANC visits and follow-up by ASHA workers are essential to improve adherence. Although the type of diet (vegetarian vs mixed) did not show statistical significance in the multivariate model, qualitative data revealed low frequency of iron-rich food consumption and high intake of tea, which inhibits iron absorption. These dietary patterns are consistent with findings from Karnataka [9] and Bundelkhand [13].

Compared regionally, Bidar's prevalence is higher than Kerala (40%) [16] but lower than Rajasthan (81.8%) [15], indicating a transitional trend typical of districts with improving but still uneven public-health delivery. The determinants identified—education, parity, spacing, and IFA adherence—mirror consistent national patterns reported across multiple Indian states [8-15]. This suggests that behavioural and reproductive factors continue to be the most tractable targets for intervention.

Limitations

This study's strengths include a robust sample size, use of standardized haemoglobin estimation, and comprehensive multivariate analysis controlling for confounders. Limitations include the hospital-based design (limiting generalizability to community settings), absence of ferritin or folate assays to differentiate iron deficiency, and potential recall bias in self-reported dietary and supplementation data.

Conclusion

Anaemia affects more than half of antenatal women in Bidar district, with mild and moderate forms predominating. The condition is significantly associated with low education, multiparity, short inter-pregnancy intervals, and poor IFA adherence. Focused interventions that address these modifiable determinants through strengthened antenatal education and community-based nutrition programs are crucial for reducing maternal anaemia.

Conflict of Interest

Not available

Financial Support

Not available

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