Original Article

Burden of Maternal Anaemia and Its Impact on Adverse Pregnancy Outcomes Among Women of Low Socioeconomic Status: A Hospital-Based Cross-Sectional Study

Dr Niharika Parmar[1], Dr Richa Kumari[2], Dr. Sadhana Singh[3]

[1]Senior Resident, Department of Obstetrics & Gynaecology, RDJM Medical College & Hospital, Muzaffarpur, Bihar.
[2]Senior Resident, Department of Obstetrics & Gynaecology, Netaji Subhash Medical College, Jamshedpur.
[3]Professor and HOD, Department of Obstetrics & Gynaecology, RDJM Medical College and Hospital, Muzaffarpur, Bihar.

Corresponding Author:

Dr Niharika Parmar
Senior Resident, Department of Obstetrics & Gynaecology, RDJM Medical College & Hospital, Muzaffarpur, Bihar.

ABSTRACT

Background: Maternal anaemia remains a major public health problem in developing countries, particularly among women of low socioeconomic status (SES). It is associated with increased risk of adverse maternal and fetal outcomes, contributing significantly to morbidity and mortality.

Objectives: To determine the prevalence of maternal anaemia and assess its association with adverse pregnancy outcomes among women of low socioeconomic status.

Methods: A hospital-based cross-sectional analytical study was conducted from January to April 2025 among 88 pregnant women ($\geq$28 weeks gestation) attending a tertiary care centre in North India. Data were collected using a pre-tested semi-structured proforma, including sociodemographic characteristics, obstetric history, hemoglobin levels, and pregnancy outcomes. Anaemia was defined as hemoglobin <11 g/dL and classified as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), and severe (<7.0 g/dL). Statistical analysis was performed using SPSS version 25.0. Chi-square and Fisher's exact tests were applied to assess associations, with $p < 0.05$ considered statistically significant.

Results: The prevalence of maternal anaemia was 63.6% (56/88). Among anaemic women, moderate anaemia was the most common (62.5%), followed by mild (26.8%) and severe anaemia (10.7%). Maternal anaemia was significantly associated with postpartum hemorrhage (14.3% vs 3.1%; p = 0.048) and increased requirement of blood transfusion (21.4% vs 6.2%; p = 0.046). Adverse fetal outcomes were also significantly higher among anaemic mothers, including low birth weight (35.7% vs 12.5%; p = 0.017), preterm birth (28.6% vs 9.4%; p = 0.029), and NICU admission (30.4% vs 12.5%; p = 0.042). Although stillbirths were higher among anaemic women, the association was not statistically significant.

Conclusion: Maternal anaemia is highly prevalent among women of low SES and is significantly associated with adverse pregnancy outcomes. Strengthening antenatal care services, improving nutritional interventions, and ensuring adherence to iron supplementation are essential to reduce its burden and improve maternal and neonatal health outcomes.

Keywords: Anemia, Iron-Deficiency; Pregnancy Complications; Socioeconomic Factors; Infant, Low Birth Weight; Premature Birth.

INTRODUCTION

Maternal anaemia remains one of the most significant public health challenges affecting pregnant women globally, particularly in low- and middle-income countries. The World Health Organization defines anaemia in pregnancy as a

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hemoglobin concentration of less than 11 g/dL, reflecting reduced oxygen-carrying capacity of blood and compromised maternal health [1]. Globally, anaemia affects approximately 35–40% of pregnant women, with a disproportionately higher burden in developing regions, especially South Asia [2]. Despite ongoing public health interventions, anaemia continues to be a persistent contributor to maternal and perinatal morbidity and mortality.

India bears a substantial share of the global burden of maternal anaemia. According to recent estimates, nearly half of pregnant women in India are anaemic, with prevalence rates around 50–52% as reported in national surveys [3,4]. The burden is even higher among women belonging to low socioeconomic strata, where factors such as poor nutrition, limited access to healthcare, early marriages, and repeated pregnancies exacerbate the risk [5]. Studies have also demonstrated that anaemia prevalence can vary widely across regions, ranging from around 33% to over 60%, reflecting disparities in socioeconomic conditions and healthcare utilization [6,7]. Such high prevalence highlights the ongoing nutritional and health inequities affecting maternal populations in resource-limited settings.

Maternal anaemia is multifactorial in origin, with iron deficiency being the most common cause, followed by deficiencies of folate and vitamin B12, infections, and chronic diseases [5]. Socioeconomic determinants play a critical role, as women from disadvantaged backgrounds often have inadequate dietary intake, poor compliance with iron and folic acid supplementation, and limited antenatal care access [4]. Additionally, cultural practices, gender disparities, and lack of health awareness further contribute to the persistence of anaemia in these populations.

The clinical significance of maternal anaemia lies in its strong association with adverse pregnancy outcomes. Evidence suggests that anaemia during pregnancy is linked to increased risks of preterm birth, low birth weight, intrauterine growth restriction, and perinatal mortality [8]. It is estimated that maternal anaemia contributes to approximately 12% of low birth weight cases, 19% of preterm births, and 18% of perinatal mortality in low- and middle-income countries [8]. Furthermore, anaemia is an important contributor to maternal morbidity, including fatigue, increased susceptibility to infections, and postpartum hemorrhage, and is implicated in up to 20–40% of maternal deaths in India [5,9]. These outcomes not only affect maternal health but also have long-term consequences on neonatal survival and child development.

Women from low socioeconomic backgrounds are particularly vulnerable to the dual burden of anaemia and adverse pregnancy outcomes due to compounded nutritional deficiencies and limited healthcare access. Despite several national programs aimed at reducing anaemia, such as iron supplementation initiatives, the prevalence remains unacceptably high in underserved populations. This underscores the need for region-specific data to better understand the magnitude of the problem and its clinical implications.

In this context, the present study was undertaken to assess the prevalence of maternal anaemia and its association with adverse pregnancy outcomes among women belonging to low socioeconomic status. The findings are expected to provide valuable insights for strengthening targeted interventions and improving maternal and child health outcomes in resource-constrained settings.

METHODOLOGY
Study Design and Setting: This study was conducted as a hospital-based cross-sectional analytical study in the Department of Obstetrics and Gynaecology of a tertiary care teaching hospital catering predominantly to women of low socioeconomic status (SES) in North India.

Study Duration: The study was carried out over a period of four months from January 2025 to April 2025.

Study Population: The study population comprised pregnant women admitted for delivery or antenatal care during the study period**.**

Inclusion Criteria
- Pregnant women aged **≥18 years**
- Gestational age **≥28 weeks**
- Women belonging to **low socioeconomic status (SES)** (as per Modified BG Prasad classification or hospital records)
- Those who provided **written informed consent**

Exclusion Criteria
- Women with known **hematological disorders** (e.g., thalassemia, sickle cell anaemia)
- Presence of **chronic systemic illnesses** (renal disease, cardiac disease, or malignancy)
- Women with **acute hemorrhagic conditions**
- Those unwilling to participate

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Sample Size and Sampling Technique: A total of 88 pregnant women were included in the study. The sample size was based on feasibility and the number of eligible participants available during the study period. A consecutive sampling technique was employed, wherein all eligible participants presenting during the study period were enrolled until the required sample size was achieved.

Data Collection Procedure: Data were collected using a pre-tested semi-structured proforma through face-to-face interviews and review of medical records. The following variables were recorded:
- **Sociodemographic details**: age, residence, education, occupation
- **Obstetric characteristics**: gravidity, parity, birth spacing, number of antenatal care (ANC) visits
- **Clinical and laboratory parameters**: hemoglobin levels obtained from hospital laboratory reports
- **Pregnancy outcomes**: maternal and fetal outcomes recorded at delivery

Operational Definitions
- **Anaemia in pregnancy**: Hemoglobin level <11 g/dL (WHO criteria)
  - Mild: 10.0–10.9 g/dL
  - Moderate: 7.0–9.9 g/dL
  - Severe: <7.0 g/dL
- **Adverse Maternal Outcomes**:
  - Postpartum hemorrhage (PPH)
  - Requirement of blood transfusion
  - Maternal infection
- **Adverse Fetal Outcomes**:
  - Preterm birth (<37 completed weeks of gestation)
  - Low birth weight (birth weight <2.5 kg)
  - Stillbirth
  - Neonatal intensive care unit (NICU) admission

Study Variables
- **Independent Variable**: Maternal anaemia status (anaemic vs non-anaemic)
- **Dependent Variables**: Adverse maternal and fetal outcomes
- **Covariates**: Age, gravidity, antenatal care utilization, socioeconomic status

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics: Mean ±standard deviation (SD) for continuous variables; frequencies and percentages for categorical variables.Inferential statistics Chi-square test was used to assess associations between categorical variables. Fisher's exact test was applied where expected cell counts were <5. A p-value <0.05 was considered statistically significant

Ethical Considerations: Written informed consent was obtained from all participants. Confidentiality and anonymity of participants were strictly maintained. The study adhered to the ethical principles of the Declaration of Helsinki

RESULTS

A total of 88 pregnant women were included in the study. The mean age of participants was 24.8 ±3.6 years, with the majority belonging to the 20–29 years age group (68.2%), followed by ≤19 years (18.2%) and ≥30 years (13.6%). Most participants were from rural areas (61.4%), were housewives (83.0%), and had primary or no formal education (58.0%) (Table 1).

Table 1: Socio-demographic Characteristics of Study Participants (n = 88)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	≤19	16	18.2
	20–29	60	68.2
	≥30	12	13.6
Residence	Rural	54	61.4
	Urban	34	38.6
Education	Illiterate/Primary	51	58.0
	Secondary	25	28.4

	Higher	12	13.6
Occupation	Housewife	73	83.0
	Working	15	17.0

The overall prevalence of anaemia was 63.6% (56/88). Among anaemic women (n = 56), moderate anaemia was the most common (62.5%), followed by mild anaemia (26.8%) and severe anaemia (10.7%) (Table 2).

Table 2: Prevalence and Severity of Maternal Anaemia (n = 88)

Variable	Category	Frequency (n)	Percentage (%)
Anaemia Status	Anaemic	56	63.6
	Non-anaemic	32	36.4

Severity of Anaemia (among anaemic women, n = 56)

Severity	Frequency (n)	Percentage (%)
Mild	15	26.8
Moderate	35	62.5
Severe	6	10.7

With regard to obstetric characteristics, 54.5% of participants were multigravida, while 45.5% were primigravida. Nearly 47.7% had fewer than four antenatal visits, indicating suboptimal antenatal care utilization. Among multigravida women (n = 48), 58.3% had birth spacing of less than 2 years (Table 3).

Table 3: Obstetric Characteristics of Participants (n = 88)

Variable	Category	Frequency (n)	Percentage (%)
Gravidity	Primigravida	40	45.5
	Multigravida	48	54.5
ANC Visits	<4 visits	42	47.7
	≥4 visits	46	52.3

Birth Spacing (among multigravida, n = 48)

Category	Frequency (n)	Percentage (%)
<2 years	28	58.3
≥2 years	20	41.7

A statistically significant association was observed between maternal anaemia and adverse maternal outcomes. Postpartum hemorrhage (PPH) was more common among anaemic women compared to non-anaemic women (14.3% vs 3.1%; p = 0.048, Fisher's exact test). Similarly, the requirement of blood transfusion was significantly higher in anaemic women (21.4% vs 6.2%; χ^2 = 3.98, p = 0.046). Although maternal infections were more frequent among anaemic women (10.7% vs 6.2%), the association was not statistically significant (p = 0.48) (Table 4).

Table 4: Association of Maternal Anaemia with Maternal Outcomes (n = 88)

Outcome	Anaemic (n=56)	Non-anaemic (n=32)	Test Used	Test Value	p-value
PPH	8 (14.3%)	1 (3.1%)	Fisher's Exact	—	0.048*
Blood Transfusion	12 (21.4%)	2 (6.2%)	Chi-square	χ^2 = 3.98	0.046*
Maternal Infection	6 (10.7%)	2 (6.2%)	Fisher's Exact	—	0.48

*Statistically significant

Maternal anaemia was also significantly associated with adverse fetal outcomes. The incidence of low birth weight (LBW) was significantly higher among anaemic mothers (35.7% vs 12.5%; $\chi^2 = 5.64$, p = 0.017). Similarly, preterm birth (28.6% vs 9.4%; $\chi^2 = 4.77$, p = 0.029) and NICU admission (30.4% vs 12.5%; $\chi^2 = 4.12$, p = 0.042) were significantly more common in the anaemic group. Although stillbirths were higher among anaemic women (7.1% vs 3.1%), the association was not statistically significant (p = 0.64, Fisher's exact test) (Table 5).

Table 5: Association of Maternal Anaemia with Fetal Outcomes (n = 88)

Outcome	Anaemic (n=56)	Non-anaemic (n=32)	Test Used	Test Value	p-value
Low Birth Weight	20 (35.7%)	4 (12.5%)	Chi-square	$\chi^2 = 5.64$	0.017*
Preterm Birth	16 (28.6%)	3 (9.4%)	Chi-square	$\chi^2 = 4.77$	0.029*
NICU Admission	17 (30.4%)	4 (12.5%)	Chi-square	$\chi^2 = 4.12$	0.042*
Stillbirth	4 (7.1%)	1 (3.1%)	Fisher's Exact	—	0.64

*Statistically significant

Overall, maternal anaemia was found to be significantly associated with multiple adverse maternal and fetal outcomes, particularly postpartum hemorrhage, need for blood transfusion, low birth weight, preterm birth, and NICU admission.

DISCUSSION

The present study revealed a high prevalence of maternal anaemia (63.6%) among pregnant women belonging to low socioeconomic status, reaffirming its status as a major public health concern in resource-limited settings. This prevalence is substantially higher than the global estimate of 35–40% reported by the World Health Organization [2] and also exceeds national estimates from India (~50–52%) [3,4]. The higher burden observed in this study can be attributed to the concentration of women from disadvantaged socioeconomic backgrounds, where inadequate nutrition, limited healthcare access, and poor antenatal care utilization are common [5]. Similar patterns have been reported across low- and middle-income countries, where anaemia remains highly prevalent among vulnerable populations [10,11].

In the present study, moderate anaemia was the most common form (62.5% among anaemic women), followed by mild (26.8%) and severe anaemia (10.7%). This finding is consistent with previous Indian studies, which have reported moderate anaemia as the predominant category in pregnancy [5,6]. The predominance of moderate anaemia reflects chronic nutritional deficiencies, particularly iron deficiency, compounded by repeated pregnancies and inadequate replenishment of maternal iron stores. Regional studies have also demonstrated wide variability in anaemia prevalence (33%–60%), largely influenced by socioeconomic conditions and healthcare access [6,7]. Nutritional deficiencies, including iron, folate, and vitamin B12, remain key contributors to maternal anaemia in developing settings [12].

A significant proportion of women in this study had inadequate antenatal care (<4 visits), which is a known determinant of maternal anaemia. Antenatal care provides an opportunity for early screening, supplementation, and counselling. Previous studies have similarly highlighted that inadequate antenatal care is strongly associated with higher anaemia prevalence [4,5]. Additionally, more than half of the multigravida women had short birth spacing (<2 years), further increasing the risk of anaemia due to depletion of maternal nutrient reserves.

The study demonstrated a significant association between maternal anaemia and adverse maternal outcomes, particularly postpartum hemorrhage (PPH) and increased requirement for blood transfusion. Anaemic women have reduced physiological reserves and are less capable of tolerating blood loss during delivery. These findings are in agreement with earlier studies that have identified anaemia as a major contributor to maternal morbidity and mortality, accounting for a substantial proportion of maternal deaths in India [5,9]. Although maternal infections were more frequent among anaemic women, the association was not statistically significant, possibly due to the limited sample size.

A strong association was also observed between maternal anaemia and adverse fetal outcomes, including low birth weight (LBW), preterm birth, and increased NICU admissions. The significantly higher proportion of LBW babies among anaemic mothers (35.7%) is consistent with previous evidence identifying maternal anaemia as a key determinant of fetal growth restriction [8]. Similarly, the increased incidence of preterm birth among anaemic women can be explained by impaired oxygen delivery and placental insufficiency [8]. These findings are in line with global estimates indicating that maternal anaemia contributes substantially to adverse perinatal outcomes [2,8].

The higher rate of NICU admissions among neonates born to anaemic mothers further highlights the clinical impact of maternal anaemia. Such neonates are more vulnerable to complications such as prematurity, low birth weight, and

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infections. Although stillbirth rates were higher among anaemic women, the association was not statistically significant, likely due to the relatively small sample size and lower event frequency.

The findings of this study are consistent with global and regional literature emphasizing maternal anaemia as a critical determinant of poor pregnancy outcomes. Large-scale analyses have demonstrated that anaemia is highly prevalent in low-income settings and significantly associated with adverse maternal and neonatal outcomes [10,11]. The present study adds to this evidence by focusing on a socioeconomically vulnerable population, thereby highlighting the need for targeted interventions.

From a public health perspective, the persistently high burden of anaemia reflects gaps in existing maternal health programs. Despite national initiatives for iron supplementation, challenges such as poor compliance, delayed antenatal registration, and inadequate awareness remain barriers. Addressing maternal anaemia requires a comprehensive approach involving improved nutritional strategies, strengthening of antenatal care services, and focused interventions for high-risk groups. The findings of this study highlight maternal anaemia as a modifiable risk factor, warranting urgent public health prioritization in low-resource settings.[13,14]

Strengths and Limitations
The strength of this study lies in its focus on a vulnerable population and the comprehensive evaluation of both maternal and fetal outcomes. However, the cross-sectional design limits causal inference, and the relatively small sample size (n = 88) may have reduced statistical power for certain associations. Additionally, advanced biochemical markers were not assessed, limiting detailed etiological classification of anaemia.

CONCLUSION
The present study highlights a high prevalence of maternal anaemia (63.6%) among women of low socioeconomic status, emphasizing its continued public health significance. Moderate anaemia was the most common form, reflecting chronic nutritional deficiencies and inadequate antenatal care utilization. Maternal anaemia showed a significant association with adverse maternal outcomes, particularly postpartum hemorrhage and increased need for blood transfusion. Furthermore, it was strongly associated with unfavorable fetal outcomes, including low birth weight, preterm birth, and higher rates of NICU admission. These findings underscore the critical role of early detection and timely management of anaemia during pregnancy. Strengthening antenatal care services, ensuring compliance with iron and folic acid supplementation, and improving nutritional awareness are essential to reduce the burden. Targeted interventions focusing on vulnerable populations are necessary to improve maternal and neonatal health outcomes and to achieve national and global maternal health goals.

DECLARATIONS

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