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Maternal Anemia as a Contributing Risk for Preterm Birth and Low birth weight

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ABSTRACT

Background: Maternal anemia is a common pregnancy complication, particularly in low- and middle-income countries, and is strongly associated with adverse perinatal outcomes. ***Aim of the study:*** This study aimed to assess the association between maternal anemia and the risk of preterm birth and low birth weight among pregnant women in Bangladesh. ***Methods:*** A retrospective observational study was conducted among 140 pregnant women admitted for delivery. Participants were categorized into anemic (n=70) and non-anemic (n=70) groups based on WHO hemoglobin cut-offs. Maternal sociodemographic, obstetric, and neonatal data were analyzed using descriptive statistics, chi-square tests, and logistic regression. ***Result:*** Preterm birth (<37 weeks) was significantly more frequent in anemic mothers than in non-anemic mothers (27.14% vs. 12.86%, p<0.01), as was low birth weight (<2500 g) (34.29% vs. 10.0%, p<0.01). Severe anemia showed the highest proportion of adverse outcomes. Low socioeconomic status and inadequate antenatal care visits (<4) were independent predictors of preterm birth, while low maternal BMI (<18.5 kg/m²) and inadequate antenatal care predicted low birth weight. ***Conclusion:*** Maternal anemia, particularly when severe, significantly increases the risk of preterm birth and low birth weight. Early detection, nutritional support, and improved antenatal care coverage may reduce these adverse outcomes.

Keywords: *Maternal anemia, preterm birth, low birth weight, Bangladesh, antenatal care*

INTRODUCTION

Anaemia is a widespread pathophysiological condition characterized by a decline in haemoglobin (Hb) concentration and red blood cell count below defined thresholds, leading to a reduced oxygen-carrying capacity of the blood and impaired oxygen delivery to body tissues [1]. Among vulnerable populations, pregnant women are particularly susceptible due to increased physiological demands during gestation [2]. Globally, an estimated 36.5% of pregnant women were anaemic, translating to more than 32 million affected individuals each year [3]. This condition is especially prevalent in low- and middle-income countries, with South Asia bearing a disproportionately high burden. In Bangladesh, recent national health and nutrition surveys have reported that approximately 50% to 48% of pregnant women suffer from anaemia substantially higher than the global average [4]. These alarming figures emphasize that maternal anaemia remains a persistent and pressing public health issue, requiring comprehensive strategies for prevention, early detection, and management [5]. Anaemia during pregnancy most commonly caused by iron deficiency is recognized as the most widespread nutritional disorder among women of reproductive age worldwide [6]. While various global initiatives, including micronutrient supplementation programs and dietary diversification efforts, have been implemented to address this issue, progress in reducing anaemia prevalence has been slow and inconsistent [7]. Despite these efforts, maternal anaemia continues to be a leading cause of maternal morbidity and mortality. Furthermore, its negative impact extends to the fetus, contributing to a wide array of

perinatal and neonatal complications [8]. This is particularly critical in resource-limited settings where routine prenatal screening and nutritional interventions may be insufficient or delayed [9]. There is a growing body of literature linking maternal anaemia with adverse pregnancy outcomes, including preterm birth, low birth weight (LBW), small for gestational age (SGA), intrauterine growth restriction (IUGR), and increased perinatal mortality [10]. Among these outcomes, preterm birth and LBW are particularly concerning, as they significantly affect neonatal survival, developmental milestones, and long-term health including cognitive and physical growth trajectories [11]. Notably, recent studies have demonstrated that anaemia occurring during early pregnancy may have a more profound impact on neonatal outcomes than anaemia identified in later trimesters [12]. This may be attributed to the physiological plasma volume expansion that begins in the second trimester, which leads to haemodilution and complicates accurate diagnosis of anaemia [13]. Hb levels measured in the first trimester offer a more reliable reflection of pre-existing iron deficiency and overall maternal nutritional status [14]. In addition to the timing of onset, the severity of anaemia plays a crucial role in determining the risk of adverse outcomes. Moderate to severe anaemia in early pregnancy significantly increases the likelihood of preterm birth and LBW, whereas mild anaemia has shown mixed associations and, in some populations, may even correlate with slightly improved outcomes [15]. Given these critical concerns, this study aimed to investigate how the severity of maternal anaemia in the first trimester influences the risk of preterm birth and low birth weight, aiming to guide early nutritional interventions for improved neonatal outcomes.

METHODOLOGY & MATERIALS

This retrospective observational study was carried out at Department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, over a one-year period from July 2024 to June 2025. The study included 140 pregnant women, divided into two equal groups of 70 each, and based on their hemoglobin levels at the time of admission for delivery, specifically in the third trimester. Classification followed the World Health Organization (WHO) criteria non-anemic and anemia.

Group A (n=70): Patients with anemia
Group B (n=70): Patients without anemia

Inclusion Criteria

- All women who delivered in the hospital during the study period and had documented hemoglobin levels at admission.

Exclusion Criteria

- Grand multiparity (parity ≥ 5)
- Hypertensive disorders of pregnancy
- Gestational or pregestational diabetes mellitus
- Antepartum hemorrhage
- Chronic medical illnesses
- Seropositive cases for HIV, Hepatitis B (HBsAg), or VDRL

Ethical Consideration

The research received approval from the Institutional Ethics Committee. Participation was entirely voluntary, and written informed consent was obtained from all individuals before inclusion in the study.

Group Classification

For the purpose of this study, anemia was defined as a hemoglobin (Hb) concentration of less than 12 g/dL during pregnancy. Furthermore, the severity of anemia was classified according to the WHO criteria. Mild anemia was defined as an Hb level between 10 and 11.8 g/dL, moderate anemia as 8 to 9.9 g/dL, and severe anemia as less than 8 g/dL. A hemoglobin level of 12 g/dL or higher was considered normal.

Maternal and neonatal outcomes were assessed in relation to anemia status. These included gestational age at delivery, where preterm birth was defined as delivery before 37 completed weeks of gestation, and late preterm referred to births occurring between 34 and 36 weeks. Birth weight was categorized as low (<2500 grams), normal (2500–4000 grams), or macrosomic (>4000 grams).

Data Collection

Data were collected post-delivery, ensuring the observational nature of the research. The database is maintained using standardized protocols, with clinical information systematically recorded by attending obstetricians immediately following delivery. Trained medical secretaries routinely verify and review the data before final entry. Collected maternal data included

age, body mass index (BMI), socioeconomic status, parity, and antenatal care (ANC) attendance. Antenatal visit adequacy was defined as having ≥4 visits during pregnancy. Obstetric and neonatal variables recorded were gestational age at delivery, birth weight, and neonatal sex. Gestational age was estimated using ultrasonography. Data related to preterm birth and birth weight were collected. Other risk factors except anemia were also doumented. All data were extracted using a predesigned checklist and anonymized prior to analysis.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Descriptive statistics summarized maternal and neonatal characteristics; continuous variables were expressed as mean ± SD, and categorical variables as frequencies and percentages. Group comparisons were performed using independent t-tests for continuous data and chi-square tests for categorical variables, with significance set at $p<0.05$. Subgroup analyses assessed preterm birth and low birth weight across anemia severity levels. Multivariable logistic regression identified independent risk factors, reporting adjusted odds ratios (AORs) with 95% confidence intervals.

RESULT

The mean maternal age was comparable between Group A (28.6 ± 5.3 years) and Group B (29.1 ± 4.8 years) (p=0.4). A significantly higher proportion of women in Group A belonged to the low socioeconomic category compared to Group B (62.86% vs. 42.86%, p=0.001). The mean BMI was lower in Group A (19.5 ± 2.6 kg/m²) than in Group B (22.7 ± 4.8 kg/m²) (p=0.02). Adequate antenatal care (≥4 visits) was reported more frequently in Group B (80.0%) than in Group A (57.14%) (p<0.001) (Table 1). Group A comprised 58.57% females and 41.43% males children, whereas Group B included 61.43% females and 38.57% males (Figure 1). Parity distribution was similar between the two groups, with no statistically significant difference (p=0.5). Preterm delivery (<37 weeks) was more common in Group A compared to Group B (25.71% vs. 12.86%, p<0.01), while term deliveries (37–42 weeks) were more frequent in Group B (82.86% vs. 70.0%). Low birth weight (<2500g) occurred significantly more often in Group A (32.86%, p<0.01), whereas normal birth weight (2500–4000g) was more prevalent in Group B. Incidence of post-term delivery (>42 weeks) and macrosomia (>4000g) was low and comparable in both groups (Table 2). Preterm birth and low birth weight were significantly more frequent among anaemic mothers compared to non-anaemic mothers (27.14% vs. 12.86% for preterm birth and 34.29% vs. 10.0% for low birth weight, both p<0.01). Within the anaemic group, severe anemia showed the highest proportion of adverse outcomes, with preterm birth in 14.29% and low birth weight in 17.14% of cases, followed by moderate and mild anemia (Table 3). Logistic regression analysis revealed that low socioeconomic status (AOR=1.65, 95% CI: 1.02–3.04, p=0.04) and fewer than four antenatal care visits (AOR=2.14, 95% CI: 1.18–3.89, p=0.01) were significant predictors of preterm delivery. For low birth weight, maternal BMI below 18.5 (AOR=2.26, 95% CI: 1.10–4.66, p=0.03) and fewer than four antenatal visits (AOR=1.89, 95% CI: 1.03–3.47, p=0.04) emerged as significant risk factors (Table 4).

Table 1: Baseline characteristics of the study population (N=140)

Variables	Group A (n=70)		Group B (n=70)		P-Value
	n	%	n	%	
Maternal Age (years), (Mean ± SD)	28.6 ±5.3		29.1 ±4.8		0.4
Socioeconomic status (Low)	44	62.86	30	42.86	0.001
BMI (kg/m²), (Mean ± SD)	19.5 ± 2.6		22.7 ± 4.8		0.02
Antenatal visits (≥4 visits)	40	57.14	56	80.00	<0.001

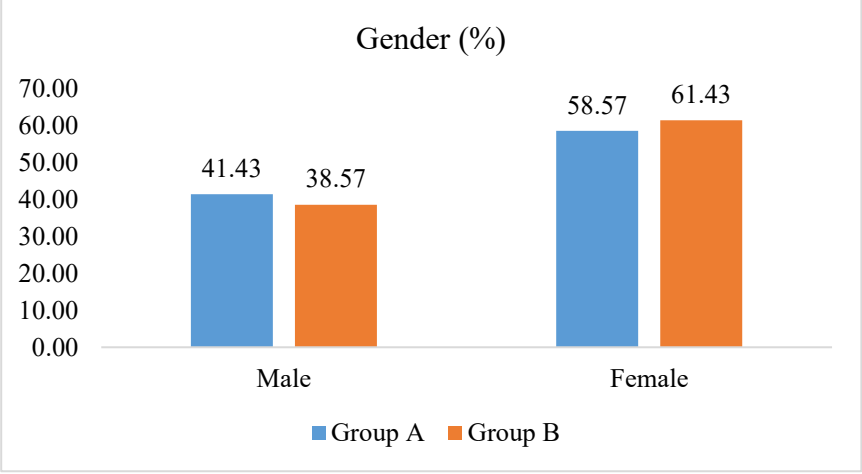

Figure 1: Distribution of child by gender

Table 2: Obstetric and neonatal characteristics by group (N=140)

Variables	Group A (n=70)		Group B (n=70)		P-Value
	n	%	n	%	
Parity					
1	17	24.29	14	20.00	0.5
2-5	29	41.43	33	47.14	
>5	24	34.29	23	32.86	
Delivery (Gestational weeks)					
<37 weeks	18	25.71	9	12.86	<0.01
37-42 weeks	49	70.00	58	82.86	
>42 weeks	3	4.29	3	4.29	
Birth weight (gram)					
<2500	23	32.86	7	10.00	<0.01
2500-4000	44	62.86	59	84.29	
>4000	3	4.29	4	5.71	

Table 3: Distribution of preterm birth and low birth weight by maternal hemoglobin status (N=140)

Hemoglobin (g/dl)	Total n	Preterm birth				Low birth weight			
		n	%	95% CI	P-value	n	%	95% CI	P-value
Anaemic	70	19	27.14	1.7–4.9	<0.01	24	34.29	0.8–1.3	<0.01
Mild	17	3	4.29	1.6–7.1		3	4.29	0.4–1.2	
Moderate	40	6	8.57	1.6–4.6		9	12.86	0.8–1.6	
Severe	13	10	14.29	2.5–9.2		12	17.14	1.6–4.8	
Non-Anaemic	70	9	12.86	0.3–0.4	<0.01	7	10.00	0.5–1.6	<0.01

Table 4: Logistic Regression Analysis – risk factors for preterm delivery and low birth weight

Variable	Adjusted OR	95% CI	P-value
Risk Factors for Preterm Delivery			
Low Socioeconomic Status	1.65	1.02 – 3.04	0.04
Fewer than 4 ANC visits	2.14	1.18 – 3.89	0.01
Risk Factors for Low Birth Weight			
BMI < 18.5	2.26	1.10 – 4.66	0.03
Fewer than 4 ANC visits	1.89	1.03 – 3.47	0.04

DISCUSSION

Maternal anemia during pregnancy is a common public health concern, particularly in developing countries, and is associated with adverse maternal and neonatal outcomes. Iron deficiency remains the leading cause, often exacerbated by poor dietary intake, infections, and increased physiological demands. Evidence suggests that maternal anemia significantly increases the risk of preterm birth and low birth weight, contributing to neonatal morbidity and mortality. Understanding this association is essential for implementing effective prevention and intervention strategies. Our study showed no statistically significant difference in maternal age between the two groups (28.6 ± 5.3 vs 29.1 ± 4.8, p = 0.4), but important social and care-related differences: a substantially higher proportion of women in Group A had low socioeconomic status (62.9% vs 42.9%, p = 0.001) and fewer reached the recommended number of antenatal visits (≥4 visits: 57.1% vs 80.0%, p < 0.001). Hussein et al found maternal median age of 24 years [14]. Other study also reported that socioeconomic factors, particularly lower socioeconomic status, are strongly associated with a higher prevalence of anemia, especially among women [16]. This is because lower socioeconomic status often limits access to adequate nutrition, healthcare, and health information, all of which can contribute to the development of anemia. In this study, mean BMI was significantly different between groups (19.5 ± 2.6 for anemic and 22.7 ± 4.8 for non-anemic group, p = 0.02). Research has found that, in Bangladesh, women who are overweight or obese are less likely to be anemic, whereas underweight women are more likely to be anemic [17]. The difference in gender proportions between the groups is small (about 3% for both male and female newborns), suggesting there is no meaningful association between child gender and maternal anemia in our sample. In this research, anaemic mothers (Group A) had substantially higher proportions of adverse obstetric and neonatal outcomes than non-anaemic mothers (Group B). The prevalence of preterm delivery (<37 weeks) was 25.7% in Group A versus 12.9% in Group B (p < 0.01), and low birth weight (<2500 g) occurred in 32.9% of neonates born to anaemic mothers compared with 10.0% among

non-anaemic mothers ($p < 0.01$). Our findings are similar to the results of AHMAD et al [18]. In this study (N = 140) anaemic mothers had substantially higher proportions of both preterm birth (27.1% vs 12.9% in non-anaemic) and low birth weight (34.3% vs 10.0% in non-anaemic), with the greatest burden among those with severe anaemia. A pooled estimate from a meta-analysis found maternal anaemia was associated with a significantly higher odds of preterm delivery (OR ≈ 1.5–1.6) and other report increased risk of LBW, particularly when anaemia occurs in early pregnancy or is more severe [19,20]. Our regression results showing that fewer than four ANC visits increases odds of both preterm birth and LBW is congruent with evidence that inadequate ANC contact is associated with adverse birth outcomes [21]. Low socioeconomic status (SES) was independently associated with preterm delivery in our sample. This echoes many population studies showing that social disadvantage is a consistent predictor of preterm birth and LBW, likely mediated through poorer nutrition, lower uptake of preventive services (including ANC and supplementation), higher infection burden, and psychosocial stressors [22,23]. Low maternal BMI (<18.5 kg/m²) predicted LBW in our model. Studies have found that maternal underweight and inadequate gestational weight gain are associated with fetal growth restriction and LBW, supporting our result that poor maternal nutritional reserves contribute to lower neonatal birth weight [24,25].

Limitations of the study:

- Hemoglobin was assessed at delivery, which may not fully reflect anemia status throughout pregnancy.
- Removing women with comorbidities or complications may have underestimated the true burden of anemia on outcomes.
- Dietary patterns, infection history, and supplementation adherence were not assessed, which may have influenced results.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that maternal anemia, particularly in its severe form, significantly increases the risk of preterm birth and low birth weight. Socioeconomic disadvantage, inadequate antenatal care, and low maternal BMI further exacerbate these risks. These findings highlight the urgent need for early detection and effective management of anemia during pregnancy through comprehensive antenatal programs, nutritional interventions, and targeted community health initiatives. Addressing maternal anemia can play a pivotal role in improving neonatal survival and long-term health outcomes in Bangladesh and similar resource-limited settings.

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