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Maternal Anemia and Its Impact on Neonatal Outcomes: A Comprehensive Analysis

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ABSTRACT
Background: *Anemia is a common pregnancy disorder with low hemoglobin levels, typically below 11 g/dL in the first and third trimesters or 10.5 g/dL in the second. It can result from malnutrition, blood loss, infections, chronic diseases, and iron and folic acid deficiencies. Affecting 38.2% of pregnant women globally, anemia is linked to adverse maternal and neonatal outcomes, such as preterm delivery, low birth weight, and postpartum hemorrhage.*
Aim of the study: *The aim of this study is to evaluate the impact of maternal anemia on neonatal outcomes.*
Methods: *This prospective observational study, conducted at the Department of Paediatrics, Medical College for Woman and Hospital, Dhaka, Bangladesh, between July 2011 to June 2012, aimed to evaluate the impact of maternal anemia on neonatal outcomes. A total of 130 patients with hemoglobin levels <7 g/dL, gravida ≤3, and singleton pregnancies were included. Exclusion criteria were specific maternal and neonatal conditions. Data on socio-demographics, maternal hemoglobin, and perinatal/neonatal outcomes (prematurity, low birth weight, Apgar scores) were collected via interviews and medical records. Statistical analysis was performed using SPSS, with continuous variables expressed as mean±SD and categorical variables as frequency/percentage.*
Result: *One hundred thirty participants were assessed for socio-demographic characteristics, with the majority (50.77%) in the 25-34 age group. The mean maternal age was 27.19±6.63 years, and 66.15% were multigravida. The mean BMI was 20.92±1.89 kg/m², and the mean hemoglobin level was 7.89±2.82 g/dL, indicating anemia. Preterm labor occurred in 13.08%, and 86.92% experienced term labor. Vaginal delivery occurred in 60%, with 34.62% neonatal ICU admissions. Neonatal complications included meconium-stained liquor (16.15%) and prematurity (13.08%). The mean birth weight was 2760±432.5 grams, with a mean gestational age of 38.1±2.0 weeks.*
Conclusion: *Maternal anemia negatively affects both maternal and neonatal health. It contributes to adverse outcomes for neonates, such as including prematurity, low birth weight, and neonatal anemia, which were also prevalent, with a high rate of NICU admissions. Early detection, timely management, and preventive measures, including iron supplementation, are crucial to reduce these risks and improve maternal and neonatal outcomes.*
Keywords: *Maternal Anemia, Neonatal Outcomes, Neonatal Anemia and Iron Deficiency.*

I. INTRODUCTION

Anemia is a common medical disorder of pregnancy, characterized by an insufficient number of red blood cells or a reduced oxygen-carrying capacity to meet physiological needs, which vary based on age, sex, and pregnancy status [1]. It is defined by hemoglobin levels less than 11 g/dL in the first and third trimesters or less than 10.5 g/dL in the second trimester [2]. Iron is a vital nutrient used in hemoglobin to carry oxygen and participate in enzymatic reactions in body tissues [3]. The condition can arise due to malnutrition, blood loss, infections, chronic diseases, and parasitic infestations, with iron and folic acid deficiencies being the most prevalent causes [4]. Anemia is a significant public health issue, especially in low- and middle-income countries, impacting 1.62 billion individuals, which accounts for 24.8% of the global population [5]. It is significant to note that 38.2% of pregnant women worldwide suffer from anemia during pregnancy [6]. Anemia during pregnancy is associated with physiological changes, including a disproportionate increase in plasma volume relative to red cell mass, leading to a physiological drop in hemoglobin levels, especially in the mid-trimester [7]. This condition exacerbates the risk of adverse maternal and neonatal outcomes, including pre-eclampsia, eclampsia, intrauterine growth restriction (IUGR), low birth weight (LBW), preterm delivery, and postpartum hemorrhage (PPH) [8]. Additionally, maternal anemia can result in preplacental hypoxia, changes in placental morphology, and alterations in fetal vascular flow, further compromising neonatal health [9]. Neonates born to anemic mothers often exhibit lower hemoglobin levels in their cord blood, and there is a linear association between maternal hemoglobin and neonatal cord blood hemoglobin [10]. Low hemoglobin levels in neonates are a critical indicator

of anemia and can predispose them to long-term health issues [11]. Maternal anemia has also been linked to lower Apgar scores, increased risk of intrauterine death, and complications such as retinopathy of prematurity. These associations underscore the critical need for early detection and management of anemia during pregnancy to mitigate its adverse effects [12]. Iron deficiency is the leading cause of maternal anemia and is often exacerbated by inadequate dietary intake, increased demands of the growing fetus, and poor iron bioavailability in certain diets [13]. Other contributing factors include deficiencies in vitamins B12, A, folate, and riboflavin, as well as infections like malaria and helminthiasis. These factors not only contribute to anemia but also elevate the risks of maternal and neonatal morbidity and mortality [13]. Despite advancements in healthcare infrastructure, maternal anemia remains a persistent challenge [14]. Severe anemia during pregnancy is associated with complications such as tachycardia, dyspnea, high cardiac output failure, and, in extreme cases, maternal mortality [15]. Moreover, it increases the likelihood of cesarean sections, red blood cell transfusions, and maternal deaths [16]. The evolving trends in anemia prevalence and its impact on pregnancy outcomes highlight the need for ongoing research to inform clinical and public health interventions. The aim of this study is to evaluate the impact of maternal anemia on neonatal outcomes.

II. METHODOLOGY & MATERIALS

This prospective observational study was conducted at the Department of Paediatrics, Medical College for Woman and Hospital, Dhaka, Bangladesh, between July 2011 to June 2012. The aim was to evaluate the impact of maternal anemia on neonatal outcomes. The institutional ethics committee approved the study, and informed consent was secured from all participants. A total of 130 patients meeting the inclusion criteria were enrolled in the study.

Inclusion criteria:

- Hemoglobin (Hb) levels <7 g/dL.
- Gravida ≤ 3.
- Singleton pregnancy.

Exclusion criteria:

- Neonates with major congenital anomalies or syndrome complexes.
- Women with a history of smoking, alcohol or narcotic drug use.
- Presence of medical conditions such as diabetes mellitus, heart disease, or renal diseases.
- Maternal malaria during the antenatal period.

Data Collection:

Patients were interviewed upon admission for delivery, and data were recorded using a pre-designed questionnaire. The data for this study were collected from a cohort of pregnant women diagnosed with anaemia and their neonates during their hospital visits. Socio-demographic data, including age, body mass index (BMI), parity, and maternal haemoglobin levels, were gathered through patient interviews and medical records.

Perinatal and Neonatal Outcomes:

Symptoms of anemia were identified by assessing clinical manifestations in the study population, with relevant information recorded. Additionally, maternal health outcomes attributed to anemia, including pregnancy-induced hypertension, gestational diabetes, and pre-eclampsia, were documented through patient history, clinical examination, and diagnostic tests. Neonatal outcomes, such as prematurity, low birth weight, and Apgar scores, were obtained from medical records and details of NICU admissions and neonatal mortality.

Statistical analysis:

All statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, version 26), and Windows. Continuous parameters were expressed as mean±SD and categorical parameters as frequency and percentage. All data were presented in a suitable table or graph according to their affinity.

III. RESULT

A total of 130 participants were assessed for their socio-demographic characteristics. The majority (50.77%, n=66) were in the 25–34 age group, followed by 36.15% (n=47) in the 15–24 age group and 13.08% (n=17) in the 35–44 age group. The mean age was 27.19±6.63 years. The mean BMI was 20.92±1.89 kg/m². Multigravida participants accounted for 66.15% (n=86), while primigravida participants made up 33.85% (n=44). The mean maternal hemoglobin level was 7.89±2.82 g/dL, indicating moderate to severe anemia (Table 1). Table 2 showed that the most commonly reported symptoms of anemia were loss of appetite and leakage, each affecting 4.62% (n=6) of the population. Cough was noted in 3.85% (n=5), followed by bleed per vagina, burning

micturition, and passing of worms, each affecting 3.08% (n=4). Fever was reported in 2.31% (n=3), while epistaxis, facial edema, and weight loss were each observed in 1.54% (n=2). Less frequent symptoms included gastritis, pancytopenia, and weakness, each affecting 0.77% (Table 2). Among adverse maternal outcomes, pre-term labor was affecting 13.08% (n=17), while 86.92% (n=113) experienced term labor. Gestational diabetes was observed in 8.46% (n=11), pregnancy-induced hypertension in 7.69%, and pre-eclampsia in 6.92%. Preterm premature rupture of membranes and postpartum hemorrhage were each reported in 5.38% (n=7). Hyperlipidemia affected 4.62% (n=6), and hyperthyroidism was noted in 3.08% (n=4). Vaginal spontaneous delivery occurred in 60.00% (n=78), while cesarean delivery was required in 40.00% (Table 3). Neonatal outcomes included meconium-stained liquor in 16.15% (n=21) and NICU admissions in 34.62% (n=45). Prematurity affected 13.08% (n=17), low birth weight and neonatal anemia were each observed in 12.31% (n=16), and hypoglycemia was noted in 11.54% (n=15). IUGR was present in 10.77% (n=14), while Apgar scores below 7 at 1 minute and 5 minutes were recorded in 10.00% (n=13) and 6.15% (n=8), respectively. The mean birth weight was 2760±432.5 grams, mean gestational age was 38.1±2.0 weeks, mean head circumference was 33.2±1.6 cm, and mean chest circumference was 30.5±2.0 cm (Table 4).

Table 1: Socio-Demographic Profile of the Study Population (N=130)

Variables	Frequency (n)	Percentage (%)
Age (in years)		
15-24	47	36.15
25-34	66	50.77
35-44	17	13.08
Mean ± SD	27.19 ± 6.63	
BMI (kg/m2)		
Mean ± SD	20.92±1.89	
Parity		
Primigravida	44	33.85
Multigravida	86	66.15
Maternal Hemoglobin Level (g/dL)		
Mean ± SD	7.89 ± 2.82	

Table 2: Symptoms of Anemia in the Study Population.

Symptoms	Frequency (n)	Percentage (%)
Loss of appetite	6	4.62
Bleed PV	4	3.08
Cough	5	3.85
Burning micturition	4	3.08
Epistaxis	2	1.54
Facial edema	2	1.54
Fever	3	2.31
Gastritis	1	0.77
Leak	6	4.62
Loss of wt.	2	1.54
Pancytopenia	1	0.77
Passing of worms	4	3.08
Weakness	1	0.77

Table 3: Adverse Maternal Health Outcomes Attributed to Anemia in the Study Population

Maternal outcomes	Frequency (n)	Percentage (%)
Pregnancy-induced hypertension	10	7.69
Gestational diabetes	11	8.46
Pre-eclampsia	9	6.92
Preterm premature rupture of membranes	7	5.38
Hyperlipidaemia	6	4.62
Hyperthyroidism	4	3.08
Post partum hemorrhage.	7	5.38
Labor		
Pre-term labor	17	13.08
Term labor	113	86.92
Mode of delivery		
Vaginal spontaneous	78	60.00
Caesarean	52	40.00

Table 4: Neonatal Outcomes in Infants Born to Anemic Mothers

Neonatal variables	Frequency (n)	Percentage (%)
	Mean ± SD	
Prematurity	17	13.08
IUGR	14	10.77
Respiratory distress	7	5.38
Sepsis	9	6.92
Hypoglycemia	15	11.54
Apgar score (1 min) <7	13	10
Apgar score (5 min) <7	8	6.15
Low Birth weight < 2500 gm	16	12.31
Meconium-stained liquor	21	16.15
Birth weight	2760 ± 432.5	
Gestational age (weeks)	38.1 ± 2.0	
Head circumference (cm)	33.2 ± 1.6	
Chest circumference (cm)	30.5 ± 2.0	
NICU admission	45	34.62
Neonatal anemia	16	12.31
Neonatal mortality	3	2.31

IV. DISCUSSION

Anemia is a prevalent health issue among pregnant women, especially in developing countries, where it poses significant risks to both maternal and neonatal health. Pregnancy outcomes can differ depending on the type and severity of anemia [17]. Anemia during pregnancy can lead to complications such as preterm birth, low birth weight, intrauterine growth restriction (IUGR), and maternal health issues, including gestational hypertension and postpartum hemorrhage [18,19]. According to the World Health Organization (WHO), anemia affects approximately 37% of pregnant women globally, with the highest burden observed in developing countries [20]. The pathophysiology of maternal anemia and its direct impact on neonatal health underscores the importance of early diagnosis and management [21]. The mean age of the study participants was 27.19±6.63 years, with a predominance of women aged 25-34 years (50.77%), similar to other studies where maternal anemia was most prevalent in women of reproductive age [22]. Furthermore, the mean maternal hemoglobin level in our study was of 7.89±2.82 g/dL, indicating moderate to severe anemia according to WHO classification [23]. The predominance of multigravida women (66.15%) aligns with findings, who reported a higher anemia prevalence among multiparous women due to depleted iron stores [24]. Additionally, the mean BMI (20.92±1.89 kg/m²) reflects undernutrition, a known risk factor for anemia in pregnancy [25]. Regarding the clinical presentation of anemia, the most commonly reported symptoms in our study were loss of appetite (4.62%) and weakness (0.77%), corroborating that fatigue and pallor are common among anemic pregnant women [26]. Notably, gastrointestinal symptoms like gastritis (0.77%) and passing of worms (3.08%) suggest possible nutritional deficiencies and parasitic infections as contributing factors [27]. The maternal health outcomes associated with anemia in our study align with those observed in the broader literature. In case of adverse maternal outcomes (Table 3), our findings show a 13.08% incidence of preterm labor, which is consistent with previous studies linking anemia to uteroplacental insufficiency and premature delivery [28]. Postpartum hemorrhage (5.38%) and pre-eclampsia (6.92%) were also more prevalent in anemic mothers, echoing the association between low hemoglobin and increased peripartum complications [29]. Our findings also revealed notable neonatal outcomes in infants born to anemic mothers. Neonatal outcomes (Table 4) reveal a concerning rate of prematurity (13.08%) and low birth weight (12.31%), aligning with studies by Albu et al. (2014), which identified anemia as a significant predictor of intrauterine growth restriction (IUGR) [30]. Our mean birth weight of 2760 ± 432.5 g was marginally higher than that reported in similar cohorts from low-resource settings, suggesting variations influenced by genetic or nutritional factors [31]. Furthermore, the 34.62% NICU admission rate underscores the burden of anemia on neonatal morbidity, with hypoglycemia (11.54%) and respiratory distress (5.38%) being prominent complications. Sepsis (6.92%) and neonatal mortality (2.31%) indicate increased vulnerability to infections and adverse perinatal outcomes. Emphasizing the critical need for maternal iron supplementation and effective anemia management programs [32]. The study's limitations include a small sample size of 130 participants, reducing statistical power. Its observational design without a control group limits causal inference. Additionally, it did not account for confounding factors such as variations in dietary intake, socioeconomic status, or access to prenatal care, which may influence outcomes.

V. CONCLUSION

In conclusion, maternal anemia significantly impacts both maternal and neonatal health. Our study reveals that anemia during pregnancy is associated with adverse maternal outcomes such as preterm labor, gestational hypertension, and postpartum hemorrhage. Neonatal outcomes, including prematurity, low birth

weight, and neonatal anemia, were also prevalent, with a high rate of NICU admissions. The findings underscore the critical need for early detection, timely management, and preventive measures, including iron supplementation, to mitigate the risks associated with maternal anemia. These results highlight the importance of addressing anemia in pregnant women to improve maternal and neonatal health outcomes.

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