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Original Research Article

Association of Maternal Anemia with Neonatal Complications and Long-Term Morbidity and Mortality among Infants Born to Anemic Mothers

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Abstract:

Background: Maternal anemia remains a major public health problem, particularly in developing countries like India, where its prevalence among pregnant women is high. It is associated with several adverse maternal and neonatal outcomes, including increased risk of morbidity and mortality among infants.

Aim: To assess the association of maternal anemia with neonatal complications and to evaluate morbidity and mortality among infants born to anemic mothers.

Methodology: A prospective observational study was conducted over six months at Department of obstetrics and gynecology, Nalanda Medical College and Hospital, Patna, Bihar, India. A total of 88 pregnant women diagnosed with anemia were enrolled and followed until delivery. Maternal hemoglobin levels were monitored during antenatal visits, and anemia severity was classified according to WHO criteria. Data on maternal characteristics, obstetric history, and neonatal outcomes were collected using a structured questionnaire. Statistical analysis was performed using Epi Info 7.

Results: Moderate anemia was the most common (50%). Low birth weight occurred in 27.3% of neonates, and 31.8% were born preterm. NICU admission was required in 20.5% of cases. Neonatal morbidity and mortality were observed in 27.3% and 4.5% of infants, respectively. A significant association was found between severity of maternal anemia and low birth weight ($p < 0.05$).

Conclusion: Maternal anemia significantly increases the risk of adverse neonatal outcomes. Early detection and effective antenatal management are essential to improve maternal and neonatal health.

Keywords: Maternal anemia, neonatal complications, low birth weight, neonatal morbidity, neonatal mortality, pregnancy.

Introduction

Anemia is one of the most significant global nutritional diseases that plague women and children alike in the global arena of public health issues to date [1]. Pregnancy is especially common where women have a higher nutritional need and physiological changes which predispose the women to deficiencies. Anemia is a major cause of maternal and neonatal morbidity, and it affects over half of all pregnant women worldwide [2]. The situation is even worse in the developing countries which are associated with poor nutrition, socioeconomic status, and access to health facilities. India, especially, bears a grossly inflated weight, with the occurrence of anemia in pregnant women reported in the country up to 87 percent prevalence rate of anemia among pregnant women was observed in India alone [3].

Anemia has been identified as one of the most important problems in the field of public health. According to the estimates of the World Health Organization, the prevalence rate of anemia in pregnancy is about 47.4 in the world. In India this is particularly worrying and it has been reported that almost one pregnant woman in every one second is anemic. Not only does maternal anemia have detrimental effects on the health of the mother, but the development and neonatal outcomes of the fetus are devastating. It is

ranked the second leading cause of maternal death in India and plays a role in almost 80 percent of maternal deaths that are linked with anemia in the South-East Asian region.[4]. These figures prove that there is an urgent need to identify, prevent, and treat anemia in pregnancy early.

Adverse outcomes of pregnancy are numerous in relation to maternal anemia. Intrauterine growth retardation (IUGR) with decreased oxygen-carrying ability of the blood and insufficient oxygen delivery to the placenta is one of the most severe results [5]. Poor outcomes of fetal growth are associated with low neonatal health status and high chances of perinatal mortality. Moreover, peri-partum anemia can undermine the health of pregnant women, causing fatigue, impaired immunity and higher chances of developing complications in labor and delivery.

The first objective of antenatal care is hence to diagnose and treat the anemia during pregnancy to produce good maternal health and enhance the outcomes of the pregnancy. Proper antenatal care offers screening, nutritional education, iron and folic acid supplements, and checking of mother hemoglobin levels. Early intervention does not only enhance maternal health but also becomes critical in terms of safety of labor and the puerperal period.

The most prevalent type of anemia in pregnancy is iron deficiency anemia, which is linked to a number of unfavorable maternal and neonatal outcomes. These are preterm birth, low birth weight, and small-for-gestational-age newborns, which are all risk factors that are associated with high neonatal morbidity and mortality. Besides, maternal anemia also enhances the chances of postpartum hemorrhage (PPH), a potentially fatal complication of childbirth [6]. Both maternal anemia and poor maternal nutritional status have been identified as the major factors that contribute to the fact that the incidence of PPH is reported to be higher in India than in the global averages.

There are specific groups of the population that are susceptible to iron deficiency anemia. They involve teenage girls, pregnant women, older infants and toddlers, preterm infants, very low birth weight babies and women in the reproductive age bracket. The high iron needs during pregnancy, coupled with the unhealthy dietary intake and the frequent occurrence of pregnancies only augment the risk of iron deficiency in the women in the low-resource areas. Consequently, maternal anemia has been a recurring problem on maternal and child health interventions in most developing nations.

According to World Health Organization, anemia during pregnancy refers to having a hemoglobin below 11 g /dl. Nonetheless, physiological hemodilution that is experienced during pregnancy especially in second trimester means that the hemoglobin level in pregnant women should not be below 10.5 g/dl during the pregnancy phase [7]. Such diagnostic criteria play a significant role in diagnosing anemia at an early stage and providing patients with timely treatment to avoid complications.

In India, anemia has been categorised according to the level of hemoglobin by the Indian Council of Medical Research (ICMR), based on which clinical management and public health interventions are directed. ICMR defines anemia during pregnancy into mild, moderate, and severe types with a hemoglobin level between 8.0 and 10.9 g/dl, between 5.0 and 7.9 g/dl, and below 5 g/dl respectively. This classification assists the medical professionals to evaluate the degree of condition severity and decide on suitable treatment approaches.

Maternal anemia is not only relevant to the outcomes of pregnancy but also could have long-term health consequences on the infants. The babies born to anemic mothers are more susceptible to such neonatal complications as respiratory distress, infections, poor growth, and developmental delays. Moreover, chronic iron deficiency in the maternal body can affect the development of fetal brains with the potential to produce a lasting neurodevelopmental disability. The complications might continue after the neonatal period, leading to high infant morbidity and mortality.

Since maternal anemia is very prevalent and may have serious implications on both mothers and babies, it is important that we learn how maternal anemia correlates with the outcomes of babies. Although there are national programs and interventions in place to help decrease the level of anemia in pregnant women, the burden has been huge in most parts of India. More studies are thus needed to determine the correlation between maternal anemia and the neonatal complications and the morbidity and mortality of infants born to anemic mothers in the long run.

The current research seeks to look at the relationship between maternal anemia and neonatal complications and long-term morbidity and mortality cases of infants born to anemic mothers. The research aims to make a contribution to the better strategies in maternal and neonatal healthcare by determining the degree and the nature of these associations and help to develop effective interventions to decrease the burden of anemia during pregnancy.

Methodology

Study Design: The present study was conducted as a prospective observational study to evaluate the association of maternal anemia with neonatal complications and long-term morbidity and mortality among infants born to anemic mothers. The study involved systematic observation and follow-up of pregnant women diagnosed with anemia during pregnancy and assessment of neonatal outcomes after delivery.

Study Area: The study was carried out in the Department of Obstetrics and Gynecology at Nalanda Medical College and Hospital, Patna, Bihar, India.

Study Duration: The study was conducted over a period of six months from March 2025 to August 2025.

Sample Size: A total of 88 antenatal women diagnosed with anemia during pregnancy were included in the study. The sample comprised pregnant women attending antenatal clinics or admitted for delivery in the Department of Obstetrics and Gynecology during the study period. Their newborn infants were also assessed to determine neonatal complications and outcomes.

Study Population: The study population consisted of pregnant women with anemia receiving antenatal care or admitted for delivery at the study hospital and their newborn infants. The maternal characteristics, obstetric history, and hemoglobin levels were documented, and neonatal outcomes such as birth weight, prematurity, neonatal complications, morbidity, and mortality were assessed.

Data Collection: Data were collected using a pre-structured and closed-ended questionnaire. Information regarding maternal demographic characteristics, obstetric history, gestational age, hemoglobin levels, treatment received for anemia, and delivery details were recorded. Hemoglobin levels were monitored during the first antenatal visit, at 30 weeks of gestation, and at 36 weeks of gestation. Neonatal outcomes including birth weight, APGAR score, prematurity, neonatal complications, and need for NICU admission were documented. Newborns admitted to the Neonatal Intensive Care Unit were evaluated and appropriate investigations such as blood cultures were performed when required.

Inclusion Criteria

- Pregnant women diagnosed with anemia during pregnancy.
- Women who delivered at the study hospital.
- Mothers who gave informed consent to participate in the study.

Exclusion Criteria

- Pregnant women with thalassemia
- Women with hemoglobinopathies
- Women with sickle cell anemia
- Women who refused to give consent

Study Procedure: All eligible pregnant women diagnosed with anemia were enrolled after obtaining informed consent. Hemoglobin estimation was carried out using Sahli's method, and peripheral smear examination was performed to determine the type of anemia. The severity of anemia was classified according to the criteria recommended by the World Health Organization. Depending on the severity of anemia, patients were managed with oral iron therapy, intravenous iron therapy, or blood transfusion. The participants were carefully monitored during the antepartum, intrapartum, and postpartum periods. After delivery, neonatal outcomes including birth weight, prematurity, neonatal complications, NICU admission, morbidity, and mortality were recorded.

Statistical Analysis: The collected data were entered and analyzed using Epi Info 7 statistical software. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used to summarize the data. The Chi-square test and Fisher's exact test were applied to assess the association between maternal anemia and neonatal outcomes. A p-value less than 0.05 was considered statistically significant."

Result

Table 1 presents the socio-demographic and obstetric characteristics of the 88 study participants. The majority of mothers were aged 21–25 years (40.9%), followed by 26–30 years (27.3%), while 15.9% were below 20 years, 11.4% were 31–35 years, and 4.5% were above 35 years. Regarding gravidity, multigravida women (56.8%) were more common than primigravida (43.2%). In terms of gestational age at delivery, most deliveries were term (≥37 weeks) accounting for 68.2%, whereas 31.8% were preterm deliveries (<37 weeks). These findings indicate that most participants were young adults, with a higher proportion of multigravida mothers and term deliveries.

Table 1: Socio-Demographic and Obstetric Characteristics of Study Participants (N = 88)

Variable	Category	Number (n)	Percentage (%)
Maternal Age (years)	<20	14	15.9
	21–25	36	40.9
	26–30	24	27.3
	31–35	10	11.4
	>35	4	4.5
Gravidity	Primigravida	38	43.2
	Multigravida	50	56.8
Gestational Age at Delivery	<37 weeks (Preterm)	28	31.8
	≥37 weeks (Term)	60	68.2

Table 2 shows the distribution of mothers according to the severity of anemia among 88 cases. The majority of mothers had moderate anemia (Hb 7–9.9 g/dl), accounting for 44 cases (50%). Mild anemia (Hb 10–10.9 g/dl) was observed in 30 mothers (34.1%), while severe anemia (Hb <7 g/dl) was present in 14 cases (15.9%). Overall, the findings indicate that moderate anemia was the most common form of anemia among the study population.

Table 2: Distribution of Mothers According to Severity of Anemia (N = 88)

Severity of Anemia	Hemoglobin Level (g/dl)	Number (n)	Percentage (%)
Mild	10–10.9	30	34.1
Moderate	7–9.9	44	50
Severe	<7	14	15.9
Total		**88**	**100**

Table 3 shows the neonatal characteristics and outcomes among 88 newborns. The majority of infants (56; 63.6%) had a birth weight between 2.5–3.5 kg, while 24 (27.3%) were low birth weight (<2.5 kg) and 8 (9.1%) weighed more than 3.5 kg. NICU admission was required for 18 neonates (20.5%), whereas 70 (79.5%) did not require intensive care. Regarding outcomes, most newborns (60; 68.2%) were healthy, while 24 (27.3%) experienced neonatal morbidity, and 4 (4.5%) resulted in neonatal mortality. These findings indicate that although the majority of neonates had favorable outcomes, a notable proportion experienced complications requiring medical care.

Table 3: Neonatal Characteristics and Outcomes (N = 88)

Variable	Category	Number (n)	Percentage (%)
Birth Weight	<2.5 kg (Low birth weight)	24	27.3
	2.5–3.5 kg	56	63.6
	>3.5 kg	8	9.1
NICU Admission	Yes	18	20.5
	No	70	79.5
Neonatal Outcome	Healthy	60	68.2
	Morbidity	24	27.3
	Mortality	4	4.5

Table 4 presents the neonatal complications among infants born to anemic mothers (N = 88). The most common complication was preterm birth, observed in 28 cases (31.8%), followed by low birth weight in 24 infants (27.3%). Fetal growth restriction was seen in 16 cases (18.2%), while birth asphyxia occurred in 10 cases (11.4%). Neonatal sepsis was the least frequent complication, reported in 6 cases (6.8%). These findings indicate that maternal anemia is associated with a considerable risk of adverse neonatal outcomes, particularly prematurity and low birth weight.

Table 4: Neonatal Complications Among Infants Born to Anemic Mothers (N = 88)

Neonatal Complication	Number (n)	Percentage (%)
Preterm birth	28	31.8
Low birth weight	24	27.3
Fetal growth restriction	16	18.2
Birth asphyxia	10	11.4
Neonatal sepsis	6	6.8

Table 5 shows the association between severity of maternal anemia and birth weight among 88 cases. Low birth weight (LBW) was more common as the severity of anemia increased. Among mothers with mild anemia, only 4 out of 30 babies had LBW, whereas 14 out of 44 cases with moderate anemia and 6 out of 14 with severe anemia resulted in LBW. In contrast, normal birth weight was more frequent in the mild and moderate anemia groups. Overall, 24 infants had low birth weight and 64 had normal birth weight. The association between severity of maternal anemia and low birth weight was statistically significant ($p < 0.05$), indicating that increasing severity of maternal anemia is associated with a higher risk of delivering low birth weight babies.

Table 5: Association Between Severity of Maternal Anemia and Low Birth Weight (N = 88)				
Severity of Anemia	**Low Birth Weight (n)**	**Normal Birth Weight (n)**	**Total**	**p-value**
Mild	4	26	30	**p < 0.05**
Moderate	14	30	44	
Severe	6	8	14	
Total	**24**	**64**	**88**	

Discussion

The results of the current research also indicate that the burden of maternal anemia is high with the moderate anemia being the most prevalent type (50% of the respondents) and the other types include mild (34.1) and severe anemia (15.9). These findings could be compared to previous studies that reported a significant percentage of pregnant women to have moderate anemia. As an example, Agarwal and Allen found a prevalence of severe anemia of 9.2% and 7% respectively, which was very close to the prevalence of severe anemia of 15.9% in the current study (Agarwal, 2012; Allen, 2000) [8,9]. Equally, Vemulapalli and Rao (2013) [10] noticed that the proportion of women who were moderately anaemic and severely anaemic among the target population was 7 percent and 6.28 percent respectively. Whereas the percentage of severe anemia in the current study is a little more, the general trend of moderate anemia being the major one is in line with these past reports".

Another significant predictor of the prevalence of anemia during pregnancy is maternal age. Most anemic mothers, in the current study, were of the age group 21 -25 years (40.9), 26 -30 years (27.3). These results can be compared to the research by Alli and Satyanarayana (2015) [11] that shows that about 40 percent of anemic pregnant women also belong to 20-24 years of the age range. The fact that these studies are similar means that anemia is likely to occur in women during their early reproductive years which can also be attributed to early marriage, frequent pregnancies and poor dietary intake. Also, the socioeconomic factors have been found to play a significant role in maternal anemia. According to Rangnekar and Rashmi (2013) [12], of the expectant mothers in their study, almost 67 percent were of lower socioeconomic statuses, which implies that a combination of poor nutritional status, support of healthcare services, and lack of prenatal care are essential factors that support the development of anemia in pregnant women. Even though the socioeconomic status was not directly measured in the current study, the demographic characteristic of the participants shows a comparable trend as typically given in the developing regions.

The gravidity and intervals between pregnancies are also considered to be some important factors that affect the prevalence and severity of anemia. Regarding the current research, over fifty percent of the respondents were multigravida (56.8), which validates the idea that recurrent pregnancy exposes the maternal body to risk of iron deficiency. Other studies done in the past have reported the same. Khandait et al. (2011) [13] noted that about 55.9 percent of the women had a birth spacing gap of less than two years and this was also linked to a high prevalence of anemia as compared to women who had longer spacing gaps. The authors proposed that insufficient gap between pregnancies could stop replenishment of maternal iron stock, thus posing more risks of anemia in future pregnancies. The occurrence of frequent pregnancies and poor birth spacing consequently plays a major part in maternal nutritional depletion and poor hematological status.

Current research has also explored birth outcomes in infants born to anaemic mothers and has discovered a significant percentage of negative outcomes. The most common complication was preterm birth (31.8%), then the low weight of the newborns (27.3%), and fetal growth restriction (18.2%). These results are consistent with other past research which has confirmed a close relationship between maternal anemia and poor perinatal outcomes. The findings were in support of the results reported by Nair et al. (2016) [14], who stated that maternal anemia was a major contributing factor to complications including preterm delivery and low birth weight. In the same manner, Sarin (2017) [15] documented that about 31.2% of anaemic women had preterm births, which are also comparable to the current 31.8% rate of preterm births. This is another similarity that supports the fact that maternal anemia is a significant risk factor that leads to preterm birth.

Another critical neonatal outcome that is related to maternal anemia is low birth weight. The low birth weight (27.3% of the newborns, or less than 2.5 kg) was designated in the current study. This observation is consistent with the previous studies that show the potential negative impacts of maternal iron deficiency in pregnancy on the growth and development of fetuses. According to Allen (2000) [9], poor maternal hemoglobin levels decrease delivery of oxygen to the fetus and this could affect the growth of the fetus and eventually lead to low birth weights. Furthermore, similar results were found by Awasthi et al. (2001) [16] in the study, in which preterm birth (9.5%), intrauterine growth restriction (37.5%), and intrauterine death (8%) were reported as adverse outcomes of the fetus. Though the percentage of intrauterine growth restriction in their study was more than in the present research, the broad direction of anemia leading to poor fetal growth is similar.

The other significant finding in the current research was that the infants of anemic mothers required neonatal intensive care. About 20.5 percent of newborns had to be admitted to the NICU, which demonstrates that there are serious issues with neonatal complications. This is relatively high compared to that of Awasthi et al. (2001) [16] who reported a 5 percent NICU admission rate. The disparity can be explained by the changes in the population of the study, the level of anemia, and the medical facilities. However, both articles emphasize that maternal anemia is a risk factor that causes the neonatal complications to develop and be treated with a special healthcare unit.

Other studies have also highlighted the relationship between maternal anemia and neonatal morbidity and mortality. Angelitta et al. (2012) [17] explained that maternal age, parity, and late prenatal care were strongly related to maternal anemia, which in turn led to poor birth outcomes including low birth weight and premature births. These results confirm the outcomes of the current research that has proved that maternal anemia correlates with neonatal complications significantly. Moreover, retrospective hospital-based study by Rohilla et al. (2010) [18] has reviewed 4,456 records of pregnant women and has found that 17.9% were anemic and 2.15 of all anemic women had severe anemia. Motheral deaths that were reported in the study were also related to severe anemia and this revealed the severity of untreated anemia in pregnancy.

A statistically significant relationship between the severity of maternal anemia and low birth weight was found in the current work ($p < 0.05$). The proportion of low-birth-weight infants increased with the severity of maternal anemia, indicating a dose–response relationship. Similar findings have been reported in several earlier studies, which suggest that as hemoglobin levels decline, the risk of adverse neonatal outcomes increases significantly (Nair et al., 2016; Allen, 2000) [14,9]. This relationship highlights the importance of early detection and effective management of anemia during pregnancy in order to improve neonatal health outcomes.

Overall, the findings of the present study are largely consistent with previous national and international research demonstrating that maternal anemia is strongly associated with adverse neonatal outcomes such as preterm birth, low birth weight, fetal growth restriction, and increased NICU admissions. These results reinforce the need for improved antenatal screening, nutritional supplementation, and health education programs aimed at preventing and managing anemia during pregnancy. Strengthening maternal healthcare services and ensuring adequate iron supplementation could play a crucial role in reducing neonatal morbidity and mortality among infants born to anemic mothers.

Conclusion

The present study concludes that maternal anemia is an important factor associated with adverse neonatal outcomes and increased risk of morbidity and mortality among infants. Most mothers in the study were young and a considerable proportion were multigravida, with a notable number of deliveries occurring before term. The majority of participants had moderate anemia, followed by mild and severe forms. Neonatal outcomes showed that while many infants were healthy at birth, a significant proportion experienced complications requiring medical attention. Common complications observed among infants born to anemic mothers included preterm birth, low birth weight, fetal growth restriction, birth asphyxia, and neonatal infections. Additionally, the severity of maternal anemia demonstrated a significant association with low birth weight among newborns. These findings suggest that maternal anemia during pregnancy can adversely affect fetal growth and neonatal health, highlighting the need for early detection, proper antenatal care, and timely management of anemia to improve neonatal outcomes and reduce long-term health risks among infants.

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